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Predicting Success at Marine Security Guard (MSG) School Utilizing the
Headquarters Master File (HMF)

by

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Submitted in partial fulfillment
of the requirements for the degree of

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from the

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ABSTRACT

The objective of this study is to utilize background characteristics to determine predictors of success from Marine Security School. The data used consist of files on fifteen MSG classes of sergeants (E5s), corporals (E4s), and lance corporals (E3s) who reported to MSG Battalion for school. These classes cover the period from December 1989 to September 1991. The data file included close to 20 background characteristics that were evaluated in this study. The logistic procedure was selected to analyze this data set since it gives a more precise picture of results than simple regression when using multiple independent variables. Six variables were found to be statistically significant below the ten percent level in predicting success of Marines at MSG school. These are the physical fitness score, rifle score, GT score, current age, current grade, race, and time in grade. Using the logit model, example cases are presented to show the user how each Marine's individual characteristics affect the probability of success or failure from MSG school.

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I. INTRODUCTION

A. BACKGROUND

Since its inception in late 1948, the Marine Security Guard (MSG) program is, and has been, the foundation of the State Department's interior security effort at embassies, consulates, and legations worldwide. Prior to this, with few exceptions, our missions abroad were guarded by American national civilian guards. This system worked well until the end of World War II.   This period saw rising costs and decreasing morale as those guards previously willing to serve without dependents, now wanted their dependents with them. At the same time more posts began to open. When it became obvious that a tightly disciplined force was required to do the job, the State Department turned to the Marine Corps. (Gutensohn, 1988)

However, what was only supposed to be a short term solution to this guard staffing problem has turned into over 40 years of unparalleled distinctive service.   It is unfortunate that most Americans have only come to know about the MSG program as a result of the Lonetree spy scandal in 1987. The program came under much scrutiny as result of this case. Fortunately, most experts and agencies who conducted indepth investigations into the matter concluded that the

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Lonetree case was an aberration. The program is alive and well! Embassy Marines, as they have come to be known, today enjoy an outstanding reputation throughout the Diplomatic world. (Gutensohn, 1988) Marines serve in over 120 countries and independent cities at over 140 embassies, legations, and consulates. There are currently more than 1400 Marines on duty at these diplomatic missions.

B. OBJECTIVE AND SCOPE

Currently, the MSG program is comprised strictly of volunteers. As a result of some minor recruiting problems (of volunteers for MSG duty) during 1991, but also due to the downsizing of the active forces in the near future, it is possible that the MSG Battalion may experience difficulties in attracting enough volunteers for MSG duty to meet all of its established table of organization (T/O) requirements. That is, there may not be enough Marines to fill all of the billets at diplomatic missions throughout the world. If it is established that a certain profile Marine would be more likely to graduate from the school than another Marine, a cost savings in human capital **and** permanent change of station (PCS) dollars could be accomplished.

The objective of this thesis is to examine predictors of success at MSG school. Most importantly, this information could be applied now to our MSG volunteer force, but could also be applied if the Marine Corps had to resort to a non-

volunteer program. In this manner, Marine Corps manpower assignment personnel could select those individuals most likely to graduate from MSG school while at the same time administering control over MOS populations.

This objective will be met by evaluating the complete data file of background characteristics from the Headquarters Master File (HMF) of Marines in the grade of Sergeant (E-5) and below from 15 recent MSG school classes. This analysis will produce a composite profile of the "ideal" Marine that we could look for in a screening process for selection to MSG school, that is, the best candidate for successful completion of MSG school.

C. METHODOLOGY

In order to obtain current and background data, files were requested and received from Headquarters, U. S. Marine Corps (HQMC) (POS), Washington, D. C. and MSG Battalion, Quantico, Virginia, on 15 recent MSG classes of sergeants and below who reported to MSG Battalion for school over a three year period (1989 through 1991). To start the ball rolling, MSG Battalion initially provided HQMC with a file containing the start date of the course, the name, social security number (SSN), grade-point average (GPA), and attrition information (if the Marine did not complete the course). This data file was then matched, by SSN, to the HMF. As a result of this matching, the data file contains the following background

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characteristics: grade, race, sex, education level, length of enlistment, Armed Forces Vocational Aptitude Battery (ASVAB) scores, physical fitness test (PFT) information, rifle marksmanship information, military occupational specialty (MOS), time in service, time in grade, and age at entry to MSG school. This data is the basis for the analysis to determine if there is a correlation between success in MSG school and other characteristics of the individual Marine. To the degree possible, individual MSG student attrition rates, and reasons therein, were also analyzed against information from the HMF.

In addition, it was imperative to at least briefly consider the non-data related issues of failure/success from MSG school. Although a data-analysis will ultimately have the biggest impact on this decision of who to send to the school, other non-data issues must also be considered to some degree. These areas should be as clearly defined as possible in Marine Corps Order (MCO) 1306.2N so that commanders in the field will be able to weed out, based on input from MSG Battalion on previous classes, those individuals that are least likely to fare well at the school.

D. SUMMARY OF CHAPTERS

To provide an understanding of the importance of the MSG program, Chapter II details the history and significance of MSGs. Chapter III of this thesis provides an overview of previous research conducted in the area of screening and

predicting success not only at MSG school, but other military schools. Chapter IV describes the process and methodology used for this thesis. Chapter V provides the data, model summaries, and an analysis of the data compiled. Chapter VI takes a look at the non-data factors that must also be taken into consideration with the quantitative results in order to give a complete picture of the potential MSG the Marine Corps is looking for. Chapter VII provides conclusions to this thesis and offers recommendations and observations derived from this analysis.

II. THE MARINE SECURITY PROGRAM

A. MISSION

The mission of the Marine Security Guards (MSGs) is to provide security services at designated United States diplomatic and consular facilities to prevent the compromise of classified material and equipment which, if compromised, will cause serious damage to the national security interests of the United States and to provide protection for United States citizens and property within the principal building of the mission. These detachments will be prepared to execute plans for the protection of the Foreign Service post and its personnel as directed by the Chief of Mission or principal officer. Under certain emergency situations they will provide special protective services to the Chief of Mission or principal officer. (U.S. MCO, 1992, p.6, Encl (5))

B. BACKGROUND

The relationship between the Marine Corps and the State Department covers nearly two centuries and can be traced from the storied "Shores of Tripoli" to the present hour. Marines have stood watch at our Diplomatic Missions from the beginnings, in times of war, insurrection, and natural calamity. The modern MSG program was initiated in 1949. More than 20,000 Marines have shared the duty since that time and have built an unprecedented institution and reputation. (Gutensohn, 1988, p.111)

Marines stood watch for varying periods at many of our missions in the years between the World Wars. As a result of this, and expeditions in Asia and the Caribbean at the dictate of American foreign policy, the Marine Corps was commonly referred to in some circles of civilians and its own members alike as "State Department Troops." With the outbreak of World War II, all experienced officers and non-commissioned officers were at a premium. Those serving outside the

overflowing training and combat commands (i.e., plenty of troops, but no leaders) were thus returned to those arenas. (Gutensohn, 1988)

With few exceptions the war years saw the hiring of American national civilians for the protection of its establishments. This system, though not the most ideal, seemed to work well during the war. Shortly after the end of hostilities, problems, both old and new, began to surface. The guards that the Department of State had been using were of doubtful character, limited ability and, in many cases, unsuitable for a position requiring such a high degree of trust and confidence. Those that had potential could see no chance of bettering their situation since there was little chance for advancement beyond the most basic Foreign Service staff levels. Guards who had previously been willing to serve abroad without dependents now wanted their families with them. Because this was viewed as unrealistically costly, morale problems began to develop. (Gutensohn, 1988)

Thus, in the period of: 1) growing international tension that existed in 1947, and 2) when scores of posts were being opened or reopened, including ultra-sensitive missions in Eastern Europe, thoughts turned toward the establishment of a guard force that was young, alert, well-trained and tightly disciplined to do the job. The Army was initially asked to assume what was supposed to be short term duties, but they declined. It was in late 1947 that the State Department again

turned to the Marine Corps by requesting that the War Department (now known today as the Department of Defense) provide enlisted Marine watchstanders and supervisory officers pursuant to the Foreign Service Act (FSA) of 1946, to furnish security services at selected missions. (Gutensohn, 1988) (Note: Specifically, the FSA of 1946 authorized the Secretary of the Navy to assign enlisted members of the Naval Service to serve as custodians at embassies, legations, and consulates under the supervision of the principal officer.) (Defense Policy Panel, 1987)

It is thought by some that the reason the Marine Crops even accepted this mission was one of political expediency. The Corps was trying to enlist the support of General George Marshall, then Secretary of State, as a counter to President Truman and Secretary of Defense Johnson during a period when support by the latter two for continued existence of the Marine Corps was waning. (Defense Policy Panel, 1987)

Again, as touched upon earlier, this duty was thought by the Marine Corps to only be a short term solution to the State Department's security problems overseas. Here we are though over 40 years later and still serving proudly in an ever-expanding role.

On December 15, 1948, a formal Memorandum of Agreement (MOA) was signed by the Secretary of State and Secretary of the Navy. The MOA has changed and been signed five times to

update administrative and control procedures, but also

specifying the use of Marines as security guards.

> The MOA explains that Marines function as armed interior
> buildings guards, and that they provide security services
> which include assuring that laws, regulations, and post
> policies relating to security matters are adhered to.
> They provide interior control of visitors and traffic
> control surveillance of construction and maintenance work,
> and a watch over the activity of foreign nationals in
> sensitive areas. They conduct in-depth security checks
> during working and non-working hours and issue formal
> security violation notices if deviations are identified.
> Marines may also be tasked with providing special
> protective services (i.e., bodyguards). (Gutensohn, 1988,
> p.6))

The MOA is, in theory, a binding agreement that outlines

the working relationship of two very large federal

bureaucracies and their members who are located in many

different posts overseas. (Shelton, 1990)

C. WATCHSTANDERS

Sergeants (E-5) and below who stand guard duty at the

Department of State missions abroad are often referred to as

watchstanders. Though at times exotic, MSG duty is, more

often than not, nothing more than walking a post overseas;

glorified guard duty if you will. (Shelton, 1987) Yet, a

Marine alone on post in an embassy or consulate, as he often

is, is in a position of great responsibility, far more so than

the average Marine of commensurate grade. Marine

watchstanders in the program come from a variety of MOS skill

experiences and backgrounds whose assignment on MSG duty is

the only duty where they will have major independent

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responsibilities. Moreover, MSGs will serve additional duties during their tour in order to help the detachment function as a team, whether it be serving as assistant detachment commander or organizing the detachment bar, ball, or mess fund.

The tour of duty is a 30 month split tour. The first 15 months is generally spent at a hardship post, while the last 15 months is spent at a non-hardship post. The definition of hardship is based on such things as economic conditions in the country/city, rigorous duty, isolation, and other extra-ordinary conditions. There are some exceptions to this such as assignments to Moscow and other Eastern European countries (sometimes referred to as designated posts), which are only six months in length. Requests for extensions both on post and on the program are considered on a case by case basis. The average watchstander is 24 years old.

In addition to what is known as Post #1 inside the main building entrances (chancery) of all overseas missions, MSGs may also stand duty on the grounds of the Ambassador's residence. Another post may be located in, or close to, the consular section (if it is distanced from the chancery). These are all armed posts and the Marine may be in military uniform or in civilian clothes (suit and tie) depending on the desires of the host country. Generally, Marines are in uniform when standing post on the embassy or consulate grounds, but may be required to wear civilian clothes when on

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duty at a post outside of the compound (i.e., the ambassador's residence).

Watchstanders generally leave the program with well-rounded skills, and greater potential and leadership skills than their peers who have not served on an independent duty of this nature. (Siverson, 1987)

D. THE DETACHMENT COMMANDER

Though this study only analyzes data on watchstanders, the role of all those in a detachment should be understood. In fact, it is the staff noncommissioned officer (SNCO) assigned to the MSG program **and** who is considered a detachment commander, (there are a few SNCOs that are on the program that are assistant detachment commanders at some of the larger detachments) that is the vital link in ensuring the communication lines remain open between the regional security officer (RSO), MSG Battalion, himself, and the watchstanders. He is there to represent the best interests of the Marine Corps, while at the same time providing constructive input to the RSO regarding security of the mission.

SNCO selection boards are briefed that a successful tour as a MSG is indicative of superior leadership qualities and that the billet assignment of detachment commander and/or assistant detachment commander requires that individuals assume a command billet or perform as an executive officer. (U.S. MCO, 1992)

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Indeed, "SNCOs assigned to the program have an awesome responsibility and must be able to lead their detachment with the highest degree of professional ability and standards. Not only must their professionalism be directed toward the Marines of the detachment, but also toward State Department personnel and, at times, foreign diplomats." (Siverson, 1987, p.20) SNCOs assigned to MSG duty are the finest the Marine Corps has to offer. Much like the watchstander, the detachment commander tour of duty is a 36 month split tour wherein 18 months will probably be spent at a hardship post and the other 18 months will be spent at a non-hardship post. The average age of SNCOs assigned to MSG duty is 29 years old, and the individual has approximately 11 years of service.

E. DUTIES AND RESPONSIBILITIES

The MSG is assigned to the embassy to safe- guard classified material, enforce security regulations, and protect American lives and property. When the embassy's daily business is completed, the Marine on duty continues the workday. MSGs check unoccupied offices for classified material left adrift, look for open doors and windows, and check the general security of the building. Safes and files are inspected to ensure they are properly secured. MSGs often escort a cleaning force of foreign employees and work closely with the embassy duty officer after working hours. MSGs must be capable of maintaining their composure in the event of riots, mob action or terrorist activity. They must be able to think clearly and follow detailed instructions at all times. MSGs work closely with their fellow Marines and in some cases with members of the United States Army, Navy, Coast Guard, and Air Force. They have daily contact with American and foreign employees of the embassy. (U.S. MCO, 1992, p.2, Encl (2))

There will also be, to a limited degree, social activities with the American community and in some countries, with foreign nationals.

   The embassy Marine represents the United States and the
   Marine Corps.   Therefore, they must present a neat
   military appearance, be adept at self-expression, and
   perform their duties in a firm, courteous and tactful
   manner The MSG could be placed in situations of possible
   compromise which require sound judgment, a high degree of
   moral integrity, honesty, loyalty, and unquestionable
   devotion to duty. (U.S. MCO, 1992, p.2, Encl (2))

Living conditions differ significantly from what the Marine, accustomed to hotel-style barracks and quonset huts in the United States and at other overseas duty locations, is likely to encounter on MSG duty.

   MSGs live together in fully furnished quarters provided by
   the Department of State. In most countries they live in
   a house with each Marine normally assigned an individual
   bedroom At those detachments where women Marine are
   assigned,   separate   bedroom,   bath,   and   toilet
   accommodations will be provided for the women. This house
   is located in the civilian community of the city or on the
   embassy compound.   The detachment members, under the
   direction of the detachment commander, are responsible for
   the operation of their quarters. They do this, as covered
   briefly earlier, by assessing, collecting, and managing
   the funds provided for the operation of the mess. MSGs
   become bookkeepers and auditors by managing the mess
   quarters for their fellow Marines. (U.S. MCO, 1992, p.3,
   Encl (2))

Marines will rotate collateral duties such as Detachment Mess Fund Manager, Detachment Bar Fund Manager, or Detachment Ball Fund Manager.

F.   SCREENING AND CRITERIA FOR THE PROGRAM

The Marine Corps uses perhaps the most extensive screening process for any assignment a Marine may be ordered to. Before a Sergeant and below can even consider applying to the program he must meet a detailed list of eligibility criteria.   The main items from that list of criteria include:

1.   Be unmarried and agree to remain unmarried until completion of their entire tour on the program.

2. Have at least 32 months obligated service remaining upon reporting to MSG school.

3.   If a corporal (E-4) or lance corporal (E-3), have minimum average conduct and proficiency markings of 4.2 and 4.2, respectively.   These performance evaluation markings are given to E-2/3/4s semiannually.

4. Be a volunteer.

5. Be a United States Citizen (by birth or naturalized).

6. Meet Marine Corps standards for personal appearance/ weight and have passed a physical fitness test within 60 days of reporting to MSG school.

7. Be medically screened for overseas assignment and class I dental.

8. Have a minimum derived AFQT/GT score of 90.
(U.S. MCO, 1992)

There are additional criteria the detachment commander must meet, but since the thrust of this thesis is on the watch-stander I will exclude these and move on.

It was decided with the inception of the program in 1948, that watchstanders would be single upon recruitment and agree to remain single during their tour of duty with the State Department. Marriage during a tour is, and always has been,

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grounds for a Marine's relief from assignment. The single watchstander policy is based upon cost of housing, travel and other expenses, and the fact that Marines don't need to be worrying about loved ones closeby when their primary focus must be on the security of the embassy. Consideration is also given to the need for immediate worldwide mobility on the part of individual Marines who could be ordered to move from post to post or continent to continent, on a moment's notice. (Gutensohn, 1988) This could be part of a permanent or temporary move to support short term diplomatic security requirements. An example of the latter might be if the Secretary of State visits an overseas location. MSG volunteers are solicited to augment the security forces for that visit. These guidelines and the justification for their continued existence remain in effect today just as they did 44 years ago at the outset of the program.

There are also factors that are considered disqualifying for perspective applicants. These include:

1. Conviction by general courts-martial.

2. Conviction by special or summary courts-martial within five years of applying for the program.

3. A record of nonjudicial punishment within one year of applying for the program.

4. A record of a civilian felony conviction with twelve months of applying for the program.

5. A history of financial instability.

6. Pregnancy.

7. Any family, personal, or medical problems which would preclude an overseas assignment.

8. Any derogatory information in an applicant's background which may jeopardize a top secret clearance.
(U.S. MCO, 1992)

Once all criteria have been met as described above, each applicant must be interviewed by his commanding officer. This interview is considered the most important element in the screening process. (Defense Policy Panel, 1987) As a precursor to this interview, the U.S. MCO (1992) highly encourages units to conduct screening boards, consisting of former MSG detachment commander or company officers. At all levels of the screening process, careful consideration must be given to the maturity, stability, financial situation, and motivation of the applicant. On the forwarding endorsements, commanders must comment on the applicant's suitability and any unique warrior or combat enhancing skills of women Marines applying for the program. In addition, an extensive "Commanding Officer's Checklist," contained in the Marine Corps Order governing the program, must be completed by the commander and then hand carried by the Marine selected for MSG school. (U.S. MCO, 1992)

As incentives, the Commanding Officer, MSG Battalion, is authorized to:

1. Add a bonus of 100 points to the composite score (for promotion) of MSGs upon completion of MSG school.

2. Meritoriously promote, or recommend meritorious promotion in the case of SNCO grades, a select percentage of

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qualified Marines to the grade of corporal through gunnery sergeant (E-7) on a quarterly basis. (U.S. MCO, 1992)

As with any process, the MSG screening program is not infallible. There will always be human failures no matter how thorough we are in screening. The only thing the Marine Corps can do is continue to take steps, as it has done, to continually fine tune the procedures used. (International Operations Subcommittee, 1987)

G. CHAIN OF COMMAND

1. State Department

Every overseas post falls under the command of a chief of mission, usually an ambassador, who is appointed directly by the President and confirmed by the Senate. The chief of mission is answerable, in strictest terms, only to the President for his actions. For MSGs, the operational chain of command then usually runs to the regional security officer (RSO), who reports directly to the ambassador, the consul for administrative affairs, or any other officers that the ambassador desires. The RSO is charged with the protection and defense of American lives, classified material, and U.S. Government property for the post or posts to which he is assigned. As such, he is the operational supervisor for the MSG detachment and directly controls and employs the Marines assigned to his security force with the operational aspects of protection and defense of overseas diplomatic missions. They are both morally and legally responsible for all that can effect the health, welfare, and safety of the Marines assigned to their care. (Shelton, 1990, p.4)

2. Marine Corps

"The administrative chain of command, which covers recruitment, training, equipping, organization, and discipline, etc., rests full authority with the Commandant of the Marine Corps and his designees: the Commanding Officer,

MSG Battalion, the Plans, Policies, and Operations (POS) Division at Headquarters, U.S. Marine Corps, and the company commander in the field." (Gutensohn, 1988, p.6)

MSG Battalion is commanded by a colonel and consists of a headquarters and training elements with about 80 permanent personnel located in Quantico, Virginia. It services 140 worldwide detachments located in over 120 countries, which range in size from six to 39 members (an average of nine per post); a total of over 1,400 Marines. Company level commands, of which there are seven, are headed up by a lieutenant colonel. He is supported by two company grade officers, usually captains, and an administrative staff that usually numbers from five to eight enlisted Marines. The companies are as follows:

- Company "A" is headquartered in Frankfort, West Germany and is responsible for detachments in Eastern Europe.

- Company "B" headquartered in Casablanca, Morocco, has under its administrative control posts located throughout North Africa and the Middle East.

- Company "C" is located in Bangkok, Thailand and is responsible for detachments in the Far East, the southern Pacific area, and those on the Asian subcontinent.

- Company "D" is headquartered in Miami, Florida and controls detachments located throughout the Caribbean and Central and South America.

- Company "E" is located in Frankfort, West Germany and has under its administrative control detachments in Ottawa, Canada and Reykjavik, Iceland.

- Company "F" is headquartered in Nairobi, Kenya and administers posts located in Eastern Africa, Madagascar, and the Mauritius Islands.

• Company "G" is headquartered in Abidjan, Ivory Coast and is responsible for detachments located throughout Western Africa. (U.S. MCO, 1992)

H. MARINE SECURITY GUARD SCHOOL

1. Mission

The mission of MSGs is to provide security services at designated U. S. diplomatic and consular facilities to prevent the compromise of classified material and equipment which, if compromised, will cause serious damage to the national security interests of the U.S., and to provide protection for U. S. citizens and property within the principal building of the mission. These detachments will be prepared to execute plans for the protection of the Foreign Service post and its personnel as directed by the chief of mission or principal officer. Under certain emergency situations they will provide special protective services to the chief of mission or principal officer. (U.S. MCO, 1992, p.6, Encl (5))

2. Scope

Prior to assignment overseas, Marines must successfully complete a course of instruction at MSG school. Instruction at the school, a brick building that is configured in and out as an actual embassy, is presented jointly by the Marine Corps (all instructors are former MSGs) and the Department of State, and funded by the latter. (Gutensohn, 1988) About 60 percent of the instruction is presented by MSG Battalion, 30 percent by the Department of State, with ten percent by other agencies. The curriculum is reviewed and updated annually.

At least five classes of 100 to 150 Marines a year are put through the rigors of this course. This equates to roughly 254 hours of classroom instruction or a total of 350

hours of a student's time when physical training, inspections, and standing duty are added in. Seventy hours of the instruction are allocated to the functional areas of "Coping with a Foreign Environment," and performing security functions. These are further divided into such areas as: conduct in a foreign environment, reporting contacts by hostile agents, deterring hostile intelligence subversion, classified material procedures, conducting security inspections, and briefings on Eastern Europe (countries once known as Eastern Bloc). The remaining instruction focuses on physical security aspects of MSG duty, such as marksmanship skills, personal protective measures, and operating security related equipment. (Defense Policy Panel, 1987)

Though Commandant of the Marine Corps General Munday states that the Marines selected for MSG duty are the "cream of the crop", (Defense Policy Panel, 1987, p.14) there is still an average 30% attrition rate from each MSG school class. The MSG school offers a very strenuous course. The schedule is:

> set up to provide students with a rigorous academic environment and an opportunity to operate under a high degree of psychological and physical stress. Pressure levels are turned up to the maximum so that instructors and full-time clinical psychologist observers can assess students before they graduate and move onto posts. Marines are also rated individually by instructors on their ability to operate in high-tension situations. They are given written personality tests and are all afforded several one-on-one sessions with the school psychologist prior to graduation. If problems, academic, training or other, are identified, a student will not graduate. (Gutensohn, 1988, p.13))

Once in the program, all MSGs are expected to maintain competence standards in their own MOS through correspondence courses offered by the Marine Corps Institute (MCI), Washington, D.C. Marines must be enrolled in a course at all times. MSGs also review professional military subjects in weekly Guard School sessions run by the detachment commander. (Gutensohn, 1988) The course is as demanding as it sounds and only those mentally and physically prepared are able to meet the challenge.

III. REVIEW OF LITERATURE

A. INTRODUCTION

The primary sources for information concerning this narrow topic were the Defense Personnel Security Research and Education Center (PERSEREC) and the Center For Naval Analyses (CNA). Points of contact established at Headquarters, U. S. Marine Corps (HQMC) and MSG Battalion provided all other studies and material available on the MSG program. Database searches using the Defense Technical Information Center (DTIC), the National Technical Information Service (NTIS), and the Semi-Automatic Bibliographic Retrieval System (SABIRS) provided the literature surrounding civilian and other military studies related to predicting success in schools and the military.

In the mid-to-late 1980s, PERSEREC evaluated a variety of predictor tests for potential use in screening and selecting MSGs. This work will help facilitate efforts to update and include more background characteristics in attempting to pinpoint the Marine that is most likely to be successful, that is, graduate, from MSG school. The data base used in this thesis will be much larger and more current than that used by PERSEREC. It will be interesting to compare whether the

results derived in this thesis differ from any of the screening criteria recommendations of PERSEREC.

Previous to this endeavor by PERSEREC, the Institute for Personality and Ability Testing, in November 1978, published a report that also looked at predictors of success of MSGs. Specifically, they examined both the watchstander and detachment commander at school and on post. They used a combination of personality tests and background characteristics for their study which will be discussed later in this chapter.

More recently, a six page preliminary report was written by the CNA in February 1992, that examined historical MSG school data and began to develop a profile of a successful MSG student. Some of the work done as part of this thesis replicates that effort, but is expanded by the inclusion of additional background characteristics and different cutoff points to help determine success at the school.

There has been little research done in the area of predicting student performance in military schools beyond basic boot camp. The few that have been done and were most closely related to this thesis were reviewed. While examining these studies, one of the common threads I noted was that predictor models are typically built from observed attrition. This thesis analyzes attrition rates, but takes the process a step further by analyzing and building a model that will predict success. To glean insight into this area, the

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literature review includes attrition studies from both the civilian and military arenas.

B. SPECIFIC MARINE SECURITY GUARD STUDIES

1. Institute for Personality and Ability Testing

From all indications, Sherman, Bergin, and Schmidt (1978) were the first to undertake the task of trying to predict success of MSGs. They analyzed psychological, demographic, and MSG school performance measures to determine which variables differentiate above average from below average MSGs in three different areas: (1) MSGs on duty; (2) watchstander candidates in MSG school; and (3) SNCOs (today known as detachment commanders). Though it looked at MSG school students, their study was primarily "designed to investigate the utility of psychological test information in identifying MSGs likely to succeed on duty (versus graduate from the school) and to select possible means of implementing relevant findings as an adjunct to current selection procedures." (Sherman et al., 1978, p.2-2) At that time attrition on the program was ten percent, whereas in 1987 it was down to around five percent (Defense Policy Panel, 1987). Though this still may seem unusually high (it is consistent with the Marine Corps-wide statistics) for such an elite force who have been thoroughly screened, the rate can be attributed to the demanding aspects of the duty and the insistence upon the highest standards of performance.

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Since this thesis deals strictly with identifying predictors of success for the Marine at MSG school and not with predicting success while actually out on the duty itself, the discussion is narrowed to only that portion of the Sherman et al., work. His group looked at two MSG classes totalling 202 students with an attrition number of 38 and rate of 23 percent. Today, that rate consistently remains over 30 percent (Akst, Quester, 1992).

For the watchstander candidate portion of the analysis, the authors separated their study into those who successfully completed training (n=164) and those who were dropped from the program by one of the screening boards (n=38). In addition to the 16 Personality Factor Questionnaire (16PF) (see Appendix A), the Motivation Analysis Test (MAT) (see Appendix A), and several variables from the MSG Student Statistical Information Sheets, measures of MSG school performance in six areas were taken from MSG school rosters and included in the study. Mean figures on such variables as: (1) time in service (TIS); (2) age; (3) General Classification Test (GCT) score [see Appendix A]; and (4) PFT score, were taken from the statistical information sheets and are found in Table 1. These sheets are filled out by the MSG student during the first week of school. A comparison of the means indicate that better GCT and PFT scores are related to a more successful MSG student. These measures are also significant factors in later studies by Wiskoff, Parker,

Zimmerman, and Sherman (1989), and Akst and Quester (1992),
and can probably be tied to self-motivation within the
individual Marine. The difference between successful and
unsuccessful in the TIS and age categories is relatively
small. Again, a comparison of these means reveals a two month
TIS difference and a .17 age difference that would just not
appear to be, as a matter of practical significance, enough to
warrant changing prerequisites. The only variable from the

Table 1. **MEAN SCORES OF MSG WATCHSTANDER CLASSES 2-87 AND 3-87 TAKEN FROM STUDENT STATISTICAL INFORMATION SHEETS**

VARIABLE	SUCCESSFUL	UNSUCCESSFUL
Time in Service (Months)	29.64	27.55
Age	20.85	20.68
GCT	108.68	98.53
Last PFT Score	225.21	204.61

Source: Institute for Personality and Ability Testing

school rosters that correlates with items to be examined in
this thesis is that of the PFT score. This can be seen in
Table 2. PFT score appears to be an indicator of success at
MSG school. That is, the higher the PFT score the more likely
the Marine is to graduate from MSG school.

Using stepwise regression, Sherman et al. (1989)
developed a model that identified the best combinations of
predictor variables that separated successful from

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unsuccessful watchstander candidates in MSG school. They felt

Table 2. **MSG CLASSES 2-78 AND 3-78 SCHOOL ROSTER PFT INFORMATION**

	SUCCESSFUL			UNSUCCESSFUL		
	LOW	HIGH	AVG	LOW	HIGH	AVG
PFT	183	300	263.8	80	227	205.7

Source: Institute for Personality and Ability Testing

the best equation that could be obtained was one in which only from the two psychological tests (PF and MAT) were utilized. It becomes difficult to understand at this point why PFT score, shown in Table 2 to vastly differ between those who were successful and those who were not unsuccessful at MSG school, was then not included as part of this "best equation," when the authors also state that "higher scores contribute to success." (Sherman et al., 1978) This is further confounded when the authors acknowledge that better MSGs (on the duty) tend to have higher PFT scores, yet that performance in MSG school "should have relatively little, if any, impact on future performance as an MSG." (Sherman et al., 1978) The authors seem to have missed tying together the apparent PFT score link between success at MSG school and success on MSG duty.

2. PERSEREC--Predicting Success at MSG School

The approach taken in this very thorough PERSEREC study was "to correlate biographical data and psychological test scores with criteria of MSG school and job performance" (Wiskoff et al., 1989, p.iv) in developing procedures to be used in screening applicants for MSG school. A total of 1,131 students in 1987 and 1988 were administered aptitude/ achievement tests and had personal history data analyzed in order to better predict performance at MSG school. This group of MSGs experienced a 27.3 percent attrition rate in school. Wiskoff et al. (1989), determined that the screening of applicants would be most effective using a combination of background variables and the Special Assignment Battery (SAB) (see Appendix A). Specifically, the background variables found to be most predictive were: (1) General Technical (GT) score (see Appendix A) from the Armed Services Vocational Aptitude Battery (ASVAB) [see Appendix A]; (2) PFT score; and (3) total indebtedness. Minimum eligibility scores were established for these variables that would reduce attrition, but not significantly reduce the pool of Marines available for MSG school (Wiskoff et al., 1989). In so doing they determined, after examining the distribution of scores in relation to a pass/fail criteria, the level at which there was a probability of the applicant passing the Screening Board evaluation of at least 50 percent.

The minimum GT score cutoff was determined to be a 90. Though the school had this requirement in place, in writing, waivers had been granted for GTs less than 90. Of these, a 50 percent attrition rate was evidenced.

Marines with a PFT score below 170 points were also found to have an attrition rate of 50 percent. Table 3 shows that as PFT score increased, the failure rate of MSGs decreased. The PFT score used by Wiskoff et al. (1989), is

Table 3. **COMPARISON OF MSG SCHOOL PASS/FAIL RATE WITH PFT SCORE**

PFT SCORE	% PASS SCHOOL	% FAIL SCHOOL
169 or Less	50%	50%
170-199	73%	27%
200-229	73%	27%
230-259	77%	23%
260-289	83%	17%
290 or More	84%	16%

Source: PERSEREC

from the inventory PFT taken upon arrival at school, not the score from the last PFT taken at the Marine's previous command. Two schools of thought exist here: (1) the perspective MSG had time to get out of shape in the 30 days of leave (maximum generally allowed) prior to reporting to the school; or (2) prior to reporting to the school, whether directly from his last command or from leave, he had time to

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get himself into shape. The relationship between the higher PFT scores and success at MSG school is best explained by the motivation and drive within the individual Marine to excel. All Marine Corps units are required to conduct physical training three times a week--some do, some don't. In order to do well on a PFT a Marine must be motivated enough to go out on his own time to run or do whatever else is required to attain the high PFT score.

Wiskoff et al.(1989) also found that MSG students with a total debt greater than $11,000 had almost twice as much of a chance at failure from the school (51%) as those whose debt was less than $11,000.

The PFT and GT scores are certainly easy enough to obtain through our automated systems, but indebtedness, though Wiskoff et al. (1989) present it differently, is a subjective area solely dependent upon information provided by the Marine. If he is untruthful or forgets information, the data becomes skewed. Thus, the study is incorrect in saying, particularly with regard to financial information, "it would be simple to employ them (GT, PFT, financial data) in screening for the MSG school." (Wiskoff et al., 1989, p.71/72) Yes, financial information, along with PFT and GT scores, would appear to be a valid predictive tool, but the data would not always be reliable enough to base an opinion on of whether an individual would be successful or unsuccessful at MSG school unless this information was provided as a result of the background

investigation (BI) required of all MSGs. However, a BI is only <u>initiated</u> once a Marine receives orders to the school. Many times the BI is not completed until a Marine is near the end of completing MSG school. Thus, this financial information could not be used as a pre-screening tool for the school, but might be utilized as a screening tool for MSG duty.

When considered separately, the following percentages of individuals would have been eliminated using the noted cutoff scores: (1) 2.9 percent for the GT score with a cutoff of 90; (2) 5.9 percent for a PFT cutoff score of 170; (3) 3.6 percent for indebtedness over $11,000; and (4) 10.4 percent for the SAB cutoff of 87 (as measured on a scale using alpha reliability percentages). (Wiskoff et al., 1989)

3.   PERSEREC--Life Experiences Questionnaire (LEQ)

The Life Experiences Questionnaire (LEQ) was conceived and developed during 1987-89 based on research undertaken by PERSEREC as part of the study by Wiskoff et al. (1989) (Parker et al., 1989). Prior to inception of the LEQ, considerable weight in the selection process at MSG school was given to background data recorded through the use of a student questionnaire. The questions were open-ended responses and as such were difficult to use in a systematic way to predict future behavior. Thus, the development of the LEQ, a biodata questionnaire in multiple choice format. The LEQ was

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administered to six MSG classes as questions were continually added, dropped, and refined in order to develop the most reliable set of LEQ scales.

> The final version of the LEQ is a 200 item, multiple choice, self-report inventory that assesses several background and temperament domains. It is divided into a number of scales, each of which has demonstrated ability to identify successful performance in MSG school. (Parker et al., 1989, p.4)

As shown in Table 4, eleven of the scales are considered to be content-homogenous while the remaining five scales are identified as nonhomogeneous. The "total adjustment," as it has come to be known, is considered one of the best predictors of success at the school. It looks at the following areas: (1) cooperativeness; (2) conscientiousness; (3) high school academics; (4) high school adjustment; (5) high school sociability; and (6) legal/alcohol trouble.

Utilizing stepwise regression of the data and factor analysis with each of the LEQ scales, it appears that LEQ is a useful measure of the background and personality characteristics thought to be required for success at MSG school and on the program. As a result of this work, the LEQ is a tool now in place and utilized at the MSG school as part of the screening process of students. More emphasis and detailed consideration though must be given to administering this test prior to a Marine reporting to MSG school as part of the screening for selection to the school, not giving the test once the individual has reported to school. The intent of the

LEQ is to screen out those less likely to successfully complete the school. So unless this is an attempt at a "concurrent" validation process, administering the test at the

Table 4. LIFE EXPERIENCES QUESTIONNAIRE (LEQ) SCALES

TYPE OF SCALE	ALPHA RELIABILITY	n ITEMS
I. CONTENT-HOMOGENOUS	NA	NA
Traditional Values	.64	10
High School Academics	.79	7
High School Adjustment	.64	5
High School Sociability	.64	7
Home/Family Life	.79	16
Legal/Alcohol Trouble	.51	4
Conscientiousness	.76	11
Cooperativeness	.76	8
Phys Fitness/Smoking	.58	5
Ethical Conservatism	.71	6
Social Desirability	.67	11
II. NONHOMOGENEOUS	.58	35
Parker-Fitz	NA	15
S-Scale	.65	50
Sherman Critical	NA	10
Random Response	NA	NA

Source: PERSEREC

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school appears to defeat this intent. This study also examined the use of background characteristics available in the HMF for predicting success at MSG school.

4. CNA--Attrition at MSG School

Due to problems encountered in 1991 by the Marine Corps in attracting enough watchstander volunteers for the MSG program, HQMC (POS) asked CNA to review recent MSG school data and from this data attempt to characterize the successful MSG student.

Specifically, CNA was tasked to "analyze the relationships between MSG school attrition and the background characteristics of Marines who recently attended the school, where these background characteristics would be restricted to only what was readily available on the on-line personnel system." (Akst, Quester, 1992) For the first time, a look at MSG school success focused on information already at the Marine Corps' disposal instead of using questionnaires and personality tests to gather the majority of this data for analysis. In addition, the characteristics used were from the Headquarters Master File (HMF) data as of the quarter prior to the start of the course, not data recorded while at school as previous studies by Sherman et al. (1978), and Wiskoff et al. (1989), had done.

Akst and Quester (1992) found that grade, PFT score, and age at entry into the MSG school were the three

characteristics which were <u>most</u> strongly associated with success/failure at the school (overall attrition rate from their data file of 1,797 records was 37.5 percent). Table 5 shows these results. Better GT and rifle scores also reflected lower attrition rates.

Table 5. MSG SCHOOL ATTRITION RATES (WATCHSTANDERS): FY1988-FY1991

	NUMBER ENROLLED	ATTRITION RATE (%)
	1,797	37.5
GRADE		
LCpl/E-3	844	42.2
Cpl/E-4	761	32.3
Sgt/E-5	192	37.0
PHYSICAL FITNESS TEST (PFT)		
Category 1	1,327	34.5
Category 2	111	60.4
Category 3	20	75.0
AGE (WHEN COURSE BEGAN)		
25 Years Old and Less	1,554	36.5
More Than 25 Years Old	238	43.5

Source: CNA

PFT score was broken into categories (or classes as the Marine Corps appropriately terms them) where Category 1 is the range of highest scores a Marine can score on the PFT and Category 3 is the range of lowest scores. In their study, Category 3 also contained those records where the PFT score

was missing. There is a higher attrition rate in Categories 2 and 3 when compared with Category 1. A wide disparity also exists between grades with regard to attrition rate. Since the age measurement indicates those 25 years old or less fared much better than those over 25 years, we can say that younger Marines have a better chance of success at the school. However, we see from the grade comparison that there is a point where this analogy does not hold up under scrutiny. Lance corporals (E-3s), who are generally younger than corporals (E-4s), performed worse than corporals. In fact, the attrition rate for lance corporals was the highest of all watchstanders. This might best be explained or attributed to a lack of maturity on the part of the younger Marine.

Though definitely useful, the scope of the CNA paper was somewhat limited. This could have been due to a constraint on time or CNA may have given the Marine Corps all that it asked for. Regardless, the door was left open by CNA (and they acknowledged such) for further research and analysis.

C.   OTHER MILITARY STUDIES

In an attempt to add credibility to the results of the MSG studies, other studies done at military schools to predict success were analyzed. The most closely related Marine Corps study found was that done by Sawyer (1978) in which he developed a model that predicted success of potential students

at the Marine Corps Communications Electronics School (MCCES).
He found that if an incoming student scored low on the
PREMATH, NRT and ASVAB test composites [see Appendix A], the
probability of success was greatly reduced. However, he also
discovered that "contradicting this was the finding that a
substantial percentage of the students were found to perform
adequately even when they had low scores." (Sawyer, 1978,
p.65) This is where a cutoff score determination must be made
that will not undermine the desired usage of low ability test
score results. Other findings of interest, and merit, that
would be applicable to MSGs were found that were non-
quantifiable. They will be discussed in Chapter VI.

When discussing "independent duty", the Marine Corps
generally refers to three distinct areas/duty assignments.
They are recruiting duty, MSG duty, and drill instructor duty.
These are all very demanding assignments where successful
completion of a tour is considered a superb indication of
leadership and promotability. Thus, a study in one of these
areas may be pertinent to the other. In fact, in a phone
conversation with Dr. Aline Quester (1992), she stated the
analysis conducted on MSGs in February 1992 (Akst, Quester,
1992) was done with the intent that the model derived could
also be used to predict success of Marine Corps drill
instructors and recruiters.

In "Attributes of Drill Instructor School Graduates:
Stress-Related Factors" (Novaco, Sarason, Robinson, and Parry,

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1983), the authors primarily considered characteristics that could be related to stress that would cause a student to fail the Drill Instructor School. In addition though, demographic, background, and aptitude factors were examined to determine their effect, if any, on graduation rates from the school. The study, unlike all others examined, found that training outcome, or successful completion of the school, was not related to aptitude scores (in this case the measure was of GCT). The inference here is that either aptitude level is not a prerequisite of the school and the duty, or that criteria for getting accepted as a drill instructor is perhaps more stringent (i.e., GCT score requirement is higher) than the other independent duty schools. In contrast, this finding of a non-existent relationship between training outcome and achievement tests differed from that part of the study that found there was a significant relationship between class standing and GCT score.

The study also showed that significantly older students were dropped from the school for psychological/behavioral reasons. The tendency was for graduates to be younger, on the mean, than non-graduates. No correlation was found between class standing and rank, years in the Marine Corps, MOS, or level of education. However, again, like the achievement tests, a significant effect was found between training outcomes and MOS. Those with a support/administrative MOS had a higher graduation rate (83.9 percent) that those with an

infantry/artillery/engineer MOS (65 percent) or air wing MOS (51 percent).

Among other things, the study concluded that demographic and personality factors distinguish graduates from non-graduates. The demographic factors they considered significant determinants were age and MOS. The results for age are perhaps counterintuitive since one might expect that candidates who are older, and thereby more mature, would be most likely to be successful. On the contrary, graduates are significantly younger than non-graduates. In addition, age was found to be inversely related to class standing for those who graduate. This suggests that maturity does not come with age and thus, individuals should not be selected for Drill Instructor School because they are older. (Novaco et al., 1983) This is contrary to the results found in the study by Akst and Quester (1992) where they found the younger Marine was <u>less</u> likely to graduate from MSG school. This becomes interesting to note since Quester (1992) felt the results from their study (Akst and Quester, 1992) could be applied to drill instructors, recruiters, and MSGs as part of a screening tool prior to them being accepted for, and reporting to, their respective schools.

> The finding for MOS is also of interest, as those with a support/administrative MOS had a graduation rate nearly 20 percent higher than that for the infantry/ artillery/ engineering group and more than 30 percent higher than air wing personnel. However, MOS had no relationship to class standing. (Novaco et al., 1983, p.12)

With regard to personality factors, one area found to be a contributor to graduation was competitiveness. The principal instrument used for this measurement was the Jenkins Activity Survey (JAS) which "assesses the subject's tendency toward coronary prone or Type A behavior along with providing an assessment of the three components of Type A behavior. These consist of speed/impatience, job involvement, and hard-driving/competitiveness." (Novaco et al., 1983) In the military this high score in competitiveness could relate to many areas, but the ones that first come to mind would be rank, rifle range, and PFT, all specific characteristics that I will examine in detail as part of this thesis. Again, this ties in with results of the MSG studies done by PERSEREC and CNA wherein high PFT scores were predictors of success at MSG school. The motivation to excel can easily be linked to an instinctive competitive drive.

To further support the claims of Sherman et al. (1978), and Wiskoff et al. (1989), that achievement test scores are determinants of success, Maskos (1991), though primarily trying to determine an optimal assignment program of Marine recruits to occupational training, found that one of the primary considerations for this placement policy was how an individual fared on the Area Aptitude Composite (AAC). The AAC is linear combinations of the scores a recruit receives in the basic tests of the Army Area Aptitude Battery. This battery, which every Marine recruit must pass, tests the

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intellectual, psychic, and motor abilities of the individual. The AACs are then used to estimate a recruit's success in follow-on training classes. "A recruit is more likely to succeed in the training class for which he or she has the highest proficiency as measured by the AAC." (Maskos, 1991, p.23) In other words, the use of this testing method helps determine, all other things considered, the occupational field the Marine will be assigned to and trained in. Again, we see the use of aptitude tests used as a means to predict success in school.

When examining predictors of academic success for graduate students at the Air Force Institute of Technology, Wilson (1969) found that year of birth was one of the best prognostic variables. His study, much like the one by Novaco et al. (1983), indicated that the younger students tend to do better. Perhaps it is because less time has elapsed between their last formal schooling (undergraduates) and their current schooling (graduate level); study skills would still be somewhat fresh as would the knowledge previously learned. Wilson did not speculate on this phenomena.

Sims (1977) set out to develop a profile of a successful Marine as a tool to be utilized by the Marine Corps Recruiting Service. The objective was to assist recruiters in weeding out potentially unsuccessful recruits. Unfortunately, Sims could only consider what limited applicant information was available to recruiters. He concluded that the most

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successful Marines in school are usually those who have completed high school, enlisted at an early age, and scored high on the ASVAB mental group composite or the ASVAB attrition composite. These results do not come as a surprise based on the results of studies already discussed in this chapter. Younger Marines and those with higher aptitude test scores seem to fare the best of all potential school students. With regard to race, Sims (1977) found that once the educational level, mental aptitude, and age of a recruit have been determined, both minority and majority racial groups have identical chances of success.

D. CIVILIAN ATTRITION AND PREDICTOR STUDIES

Though outside the realm of military-related studies, considerable work has been done on predicting success in the civilian academic world. Interestingly enough, some of the findings carry-over and apply in some areas that will be examined with the MSG school student. In addition, other findings report the successful use of biographical/background questionnaires with perspective students.

Similar to the findings of Sherman et al. (1978), Wiskoff et al. (1989), and Akst and Quester (1992), in a study of 35 percent of the freshman class at the University of Texas by Fudge (1970), it was found that biographical data could be effectively used to predict academic performance. When coupled with aptitude test scores (Scholastic Aptitude Test

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(SAT) and American College Test (ACT)) a much better estimate of academic performance could be obtained than through the commonly used predictive index of high school GPA and aptitude tests. Thus, the more information available on an individual, the more accurately success can be predicted. This would suggest that if an aptitude score such as GT could be used in conjunction with other background data and the Life Experiences Questionnaire adopted by Parker et al. (1989), the success of a Marine at MSG school could be better predicted.

Self-reporting biographical questionnaires have not been used much for selection purposes at educational institutions. There are two basic reasons for this. One, extensive research using questionnaires as predictors in the academic environment has been limited; and two, the possibility of some characteristic in an individual filling out the questionnaire may already exist that would be a bias, good or bad, in the selection process for admission.

All of the civilian-related studies I reviewed indicate that achievement test scores are an excellent indicator/predictor of success. When these test results are used in conjunction with previous grades and pertinent biographical data, the predictive capability is usually improved.

E.   CONCLUSION

The research reviewed in this chapter has focused primarily on background characteristics and various testing programs that can assist users in predicting success in various military and civilian arenas.

For the most part, the results aren't that surprising. In all but one analysis (Novaco et al., 1983), achievement test scores were an indicator of success either on the job, in school, or in the military. The majority of studies also showed that age was inversely related to success.

In each of the three analyses done on MSG school attrition, PFT and GT scores were found to be predictors of success. Cutoff scores were chosen for each at which point a determination could then be made regarding which individuals were most likely to succeed/ fail from the school. The exact cutoff scores for each variable differed with each study.

This thesis, using the same data as that used by Akst and Quester (1992), will take a more indepth look at the same categories they did, in addition to others, to determine more specifically where the statistically significant levels of success are found. The results can then become an additional tool to determine whether a Marine is qualified for admission to MSG school.

IV. METHODOLOGY

A. INTRODUCTION

Prior to Akst and Quester (1992), research into predicting success at MSG school focused primarily on PFT scores, GT scores, psychological testing, and the use of questionnaires. The measured effect of these variables on success at the school may be biased by the omissions of previously unmeasured variables available in the HMF.

This chapter is concerned with looking at the selected sample's composition, and describing the underlying data set. In addition, the selection of the statistical methods used in the development of the problem are discussed. Subsequent chapters are concerned with the discussion of the results and the conclusions.

The objective of this analysis is to predict success, which is defined as graduation from the MSG school. Failure, or attrition from the school, means that the Marine, for whatever unidentified reason, did not successfully complete MSG school.

The computational hardware used for this thesis included the Naval Postgraduate School's IBM 3033 370 mainframe running an MVS batch system. The software package used for the analysis was SAS, version 6.07. This program provided an

informative overview of the large volume of data. There were over 1800 subjects contained in the data base, with nearly 20 variables to be considered for each subject.

B. DATA ACQUISITION AND ORGANIZATION

The data consist of files requested and received by the CNA from Headquarters, U.S. Marine Corps (HQMC) (POS), Washington, D.C. and MSG Battalion, Quantico, Virginia, on fifteen recent MSG classes of sergeants (E-5), corporals (E-4), and lance corporals (E-3) who reported to MSG Battalion for school. These classes were held over a three year period between December 1989 and September 1991. It was the CNA who provided the complete data file in ASCII format after obtaining approval for its release from HQMC and MSG Battalion. Not all of the variables included in that file were used for the thesis and some recoding was necessary for compatibility with the NPS mainframe, the SAS program, and to ensure the objectives of this thesis are met.

This effort of compiling data began in late 1991 with MSG Battalion providing HQMC with a file containing the start date of the previous fifteen classes, along with the name, social security number (SSN), grade point average (GPA), and attrition information (if the Marine did or did not complete the course) of each Marine enrolled in the course. Thus, the data were initially broken out by class, but for this study are analyzed cumulatively.

This data file was then matched, by SSN, to the HMF. As a result of this matching, the newly merged data file included all of the background characteristics listed in Table 6. These background characteristics, or independent variables, represent data contained in the HMF subsequent to the start of each course. Referring back to Chapter III, this is different from previous MSG studies which looked at data accumulated after the Marine reported to MSG school. So, this new data file is the basis for the analysis to determine if any link exists between success in MSG school and other characteristics of the individual Marine. When this link is apparent, the Marine can be described as an "ideal" selection for MSG school. Table 6 is provided to enable the reader to understand those variables contained in the HMF and at MSG school that were available for exploration and examination. In addition, the variable name utilized and now recognized in SAS in conjunction with this data set and thesis is listed. Ultimately, six variables from this list were found to be the best explanation of success at the MSG school.

There were 1,829 SSNs provided by MSG school to HQMC for those Marines who had attended one of the fifteen classes. Of these, 1,794 were successfully matched. This disparity of 35 records appears to come from either incorrect entries of SSNs into the computer or they are students who were recycled into a later class. Due to the time and difficulty involved in

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Table 6. BACKGROUND CHARACTERISTICS/VARIABLES

VARIABLE	VARIABLE NAME IN SAS
NAME	NAME
GRADE	PAYGRADE - E3, E4, E5
SOCIAL SECURITY NUMBER	SSN
SEX	SEX - MALE, FEMALE
RACE	RACE - WHITE, BLACK, HISPANIC
PRIMARY MOS (MOS)	PMOS
CURRENT ENLISTMENT	ENLIST, ENL2ND, ENL1ST2D
LENGTH OF ENLISTMENT	LENENL
EDUCATION LEVEL	EDUCLEV
PFT SCORE	PFTSCORE
RIFLE SCORE	RIFLESCR
MARITAL STATUS	MARSTAT
ETHNIC BACKGROUND	ETHNIC
TIME IN SERVICE (TIS)	TIS
TIME IN GRADE (TIG)	TIG
ASVAB SCORES	GTVE, ELCIAR, MMMAPA, CL
CURRENT AGE	AGE
AGE ENTERED USMC	AGEENTRY
MSG SCHOOL CLASS AVERAGE	AVG
NUMBER OF DEPENDENTS	NODEPN

trying to investigate which of these alternatives it is, and because the number represents only about 1.9 percent of the total records, it was considered not worthwhile to attempt to correct or locate the missing SSNs for this effort. (Akst and Quester, 1992) There are also 28 students who were recycled for indeterminable reasons and for whom it was impossible to ascertain, given the information provided, whether they attended another class or not. These were dropped from the data set. These 28 actually whittled down to 24 since four were from the 35 whose SSNs could not be matched in the HMF. As discussed in the next section, females were also dropped

from the data set due to their relatively small numbers. The basis then for this analysis is 1737 observations.

With that said however, when an individual characteristic or variable is examined, more numbers begin to drop off. For example, if a "0" exists in the field where a PFT score should be, this is a record that cannot be included in the data set for analysis. This missing score, number, or letter fluctuates between variables. So, PFT may show 36 missing scores, while the variable for rifle score, RIFLESCR, may show 152 missing scores (these are in addition to the 35 records that initially could not be matched when the MSG school records and HMF were combined and the 24 Marines who were recycled).

C.   DESCRIPTION OF VARIABLES

Because MSG duty has gone through periods when women were both allowed and not allowed to volunteer for the MSG program, not many women currently are on post. As a result, 33 women attending MSG school over the period of time being analyzed is quite small (1.8 percent) and not representative enough to draw any conclusive evidence from regarding their success at the school versus their male counterpart. Despite this, the results of their success will be outlined later. Currently, females are allowed on the duty and further research, involving more data, may be appropriate to analyze the use of sex as a further predictive tool for success of females at the

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school. To avoid skewing results, females have been dropped from the data file.

For the variable RACE, only enough observations were available for the larger groups to make any separate statistical inferences on performance at the school. These groups were labeled as WHITE, BLACK, and HISPANIC. An "other" category was initially created for American Indians, Alaskan natives, and those of Pacific or Asian descent. However, since this group comprised only 1.3 percent of the population, they were included in the WHITE category.

The PFT scores ranged from zero, where obviously no score had been input into the HMF by the Marines' former unit, to a perfect score of 300. The PFT is broken down into first class (highest), second class, and third class (lowest) categories. The class a Marine falls into depends on age as shown in Table 7. Requirements become more lenient as one grows older. The

Table 7. PFT POINT SCORING SYSTEM

AGE	1st CLASS (points)	2nd CLASS (points)	3rd CLASS (points)
17-26	300-225	224-175	174-135
27-39	300-200	199-150	149-110
40-45	300-175	174-125	124-85

analysis of PFT scores for this thesis is based on these class distinctions and will be covered more in-depth in Chapter V.

The rifle score is also broken down into a point system. In order to qualify with the weapon a Marine must attain a minimum score of 190. A score of 250 (all bulls eyes) is a perfect score. To attain the highest level of marksmanship, classified as expert, a Marine must attain a score between 220 and 250. The designation of sharpshooter is for those with a score between 210 to 219, and a score between 190 and 209 will earn the classification of marksman. Again, as for the PFT, the analysis of success and failure rates at MSG school using rifle scores is based on these three levels of marksmanship.

Both PFT and rifle score impact directly on a Marines's promotion up to and including the grade of Sergeant (E-5). Thus, a Marine desiring to get promoted will put forth the extra effort in order to excel and eventually be promoted. It is apparent then, as discussed in Chapter III why these are self-motivating measures of success. How far a Marine goes in his career and how well he does becomes very dependent upon his desire to perform well in all that he undertakes. Though the analysis for the PFT and rifle variables was based on specific class and category cutoffs, other cutoffs were examined and will also be discussed.

Since there is generally a relationship between MOSs within occupational fields, MOSs were coded so that all those beginning with the same two numbers were part of one

occupational field. Occupational field (occfield) is in fact how the Marine Corps assigns its monitors, known as occfield sponsors. For instance, a monitor having cognizance over Marines in the "01" occfield will make assignments for all Marines in MOSs 0121, 0131, 0141, 0151, 0161, and 0193. These are all administrative MOSs. After individual MOSs were coded into occfields, the attrition rates were examined. Because some occfields contained as little as one individual, it was impractical to look at attrition rates by occfield in all cases.

Due to the small size of some of the occfields, I took the MOS issue a step further by placing the occfields into categories that were descriptive of their mission and which are most recognized in the recruiting and retention arenas. These were:

1. Combat Arms

2. Combat Support

3. Combat Service Support

4. Aviation Support;

Further discussion and an analysis of the MOS variable in this context can be found in Chapter V.

A number of the variables contained in the HMF are closely related and were, not surprisingly, found to be highly correlated. The measure of this correlation was accomplished using correlation tables, the variance inflation factor (VIF), and collinearity functions in the SAS program as described in

SAS Institute Inc. (1990). I suspected that the TIS, TIG, current age, age entered USMC, and grade variables would be correlated with each other to some degree. It was then a matter of determining where the highest correlation existed and discarding variables that had little to no explanatory value from the initial model in order to derive the final and best explanatory model of success at the school. High VIFs (over five) helped identify and whittle the number of these variables down.

Should this particular data set be examined further, the only other variable of question and worth discussing was DROPFLAG21. This was created at the request of the CNA to examine those Marines who had dropped from MSG school within the first 21 days of reporting to the school. They thought that the reason for Marines dropping within such a short period of time perhaps was not due to anything at the school, but due to poor screening by the previous command who had, because of this poor screening, sent an unqualified Marine to the school. This thesis does not examine the DROPFLAG variable since the CNA found there was no basis for this assumption.

All other variables and background characteristics to be analyzed require no specific discussion since they are relatively self explanatory. In addition, the Marine has little control over these variables once at the point of applying for MSG duty. The only exceptions to this would be

the ASVAB which is based on a test that can be retaken every six months in order to improve the scores, and the education level which can be increased through off duty education or correspondence courses.

D. STATISTICAL METHOD UTILIZED

Initially, regression analysis was performed and frequency tables and correlation tables were created with SAS for all variables in the HMF. This was done to check coefficient signs (positive or negative) to see if they were what was expected, to look at the total categorical numbers, and to ensure that any coding done for the variables in the HMF was correct and understood. No glaring complications arose from this.

The selection of the logistic procedure to analyze the data set was a logical choice since it fits linear regression models for binary or ordinary response data. It also gives a more precise picture of results than simple regression when using multiple independent variables. Since this study deals with success or failure at MSG school, these are referred to as binary response variables (a choice of two variables). Logistic regression is a procedure that has come to be accepted in most social science disciplines as the correct methodology when one wishes to perform regression analysis with dichotomous dependent variables, such as whether an individual succeeded or failed at school. (Studenmund, 1992)

In contrast to ordinary regression which models the data to a line, logistic regression models the data as an s-shaped curve. The logit model was created to correct a major problem in the linear probability model, wherein some predictions will fall outside the parameters of the linear probability model. This means that predictions will be less than zero or greater than one. The logit model thus needed to be used to correct for this deficiency. The model transforms the problem of predicting the probabilities within a (0,1) interval to the problem of predicting odds of an event occurring within the range of the actual value <u>and</u> closer to the actual value than the probit model as you move further away from the middle of the curve or 0.5. A further discussion of binary response methodology and the logistic procedure and logit model can be found in Studenmund (1992) and Cox and Snell (1989).

The logit model for this thesis is defined as:

$$P\ (Success\ at\ MSG\ School) = \frac{1}{1 + e^{-(\beta_0 X_0 + \beta_1 X_1 + \ldots + \beta_k X_k)}}$$

where **P** is the probability that an individual will graduate from MSG school and **e** is the base of the natural logarithm (approximately equal to 2.718). The **X**s are the values of the explanatory variables, the betas, or **B**s, are the values of the estimated parameter or coefficients of the model, and **k** denotes the number of explanatory variables measured for each individual. The value of the dependent variable "GRAD2" was interpreted as the probability of success at the MSG school

when used in conjunction with variables from the HMF as a basis for this success.

The logistic procedure of the SAS program was originally designed for the medical community to identify anomalies. For this reason it was set up by ordered value, wherein "1" is the anomaly, and "2" is the most common occurrence. For this thesis, as in most applications in the business world, the ordered value lists the success as the "1" and failure as the "2". In order to do this with the logistic procedure in SAS the DROPFLAG variable merely needed to be renamed GRAD and recoded for my use as GRAD2. This was the only difficulty, if it can even be classified as such, that was experienced with the use of the logistic procedure.

Stepwise regression is often used when trying to predict success or failure with multiple variables. Due to the relatively small amount of variables being examined for use in this thesis model, I elected to use stepwise regression only after all other methods of comparison had been utilized so that I would avoid being swayed by these results. These methods and tests used included determining which variables I thought would work best in predicting success at the school, in addition to the VIF, classification table (CTABLE), Durbin-Watson (DW), regression, collinearity (COLLIN), correlation, and frequency options. As it turned out, the stepwise procedure identified the same variables I had previously selected using the methods mentioned, for the best explanation

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of the data, that is, those variables with the highest statistical significance.

Additionally, in further assessing the model for fit, the log likelihood test demonstrated a probability of .0001, indicating the variables used significantly explained the graduation/non-graduation rate attained at MSG school.

V. PRESENTATION OF DATA AND DATA ANALYSIS

A.   INTRODUCTION

Utilizing the variables discussed in Chapter IV, this chapter presents the results of the statistical procedures produced through the use of the SAS program. Again, the objective is to determine which independent variables best explain success at MSG school and will ultimately comprise the explanatory variables in this prediction model. The variable GRAD2 which was coded to list all those who graduated from MSG school as a "0" and those who failed as a "1", is the dependent variable.

Frequency tables gave an initial and sometimes interesting perspective of this issue. This step ensured enough observations were available in all areas and gave a feel for the information the model might include. These frequencies are listed and discussed for many of the variables, particularly those whose numbers were too small to use as a basis for any analysis. GRAD2 was also plotted against each of the independent variables to determine actual graduation and non-graduation rates.

Correlation tables were created for all independent variables to determine if and where correlation problems existed. These problems were systematically dealt with

through the careful elimination of variables from the model until only a couple of understandably correlated variables were left. Tables are contained and a further discussion is covered in this chapter.

Lastly, as a culmination to all of this analysis and of the logistic procedure, the best predictive model available from the data and variables used will be presented. A base case, using means and coefficient values, is computed and provided as an example for future applications.

B. ANALYSIS OF VARIABLE FREQUENCIES NOT USED IN THE MODEL

Once the data were converted from ASCII to a usable form for SAS, the first thing accomplished was listing frequencies for all of the variables available. Foremost was taking a look at the overall graduation and non-graduation rates. Table 8 outlines the numbers and indicates that the attrition rate from the fifteen MSG classes is 36.5 percent from the school. This appears to be an unusually high percentage of the student population that fail the school. The key to this would be to know exactly what the reasons were for these failures. The first thought is that the high attrition is due to the demanding rigors of the course. It could also be that previous commands have conducted poor screening of the potential MSG and he is found not qualified once he has reported to the school. Actual attrition for problems once the Marine has begun the course may be small. Unfortunately,

Table 8. OVERALL GRADUATION AND NON-GRADUATION RATES

	NUMBER	PERCENTAGE
GRADUATE	1104	63.55%
NON-GRADUATE	633	36.45%
TOTAL	1737	100.0%

the reasons for failure from the school were not provided by MSG school for this study, though these records are maintained for each class.

Variables not used as part of the final predictive model include those in Table 9. Some of these are worth elaborating on, others are not. The class average is not relevant since the data file carried only a class average for those Marines who actually graduated from the school. None of the other variables provided by MSG school were utilized for analysis. A discussion of the other variables follows.

The Marine Corps breaks down education level into twelve distinct categories. Of these, recipients of high school diplomas constitute 93.1 percent of this group, while the only other groups above one percent were those with a high school certificate of attendance (2.4 percent) and those with a general equivalency diploma (one percent). With such a small percentage in each of these other eleven categories, a closer analysis did not seem warranted.

Table 9.   **VARIABLES FROM THE HMF NOT USED IN THE PREDICTIVE MODEL**

PRIMARY MOS (MOS)	MARITAL STATUS
CURRENT ENLISTMENT	TIME IN SERVICE (TIS)
LENGTH OF ENLISTMENT	MSG SCHOOL CLASS AVG.
EDUCATION LEVEL	AGE ENTERED USMC
ASVAB SCORES - ELCIAR, MMMAPA, CL	

With regard to ASVAB testing, the portion of this battery of tests used with the most consistency for qualification to different jobs, programs or MOSs, is the GT. (See Appendix A) There is a minimum GT score requirement of 90 for admittance to the MSG program. Since no other part of the ASVAB tests are used with relation to MSGs they have not been evaluated. GT score was found to be a significant predictor of success at MSG school and will be discussed later.

The ethnic variable contains sixteen different and distinct categories. The largest, constituting 90.1 percent, claimed they were not a part of any specific ethnic group. Only two other groups of this sixteen had numbers above one percent of the population, Puerto Ricans at 1.3 percent and those with Mexican ancestry at 4.3 percent. Since so few claimed ethnicity outside of the "none" category and because the race variable was analyzed and found to be statistically significant at the ten percent level, further research of the ethnic background characteristic was not considered warranted.

So many of the variables had the potential to suffer from multicollinearity that it was imperative to determine, if given a choice between two variables, which was the easiest or most readily available to use and understand. Such was the case with the variables that delineated current age and the age at which the individual entered the Marine Corps. I opted to use current age since that was the most readily available information to the user. In addition, and very important in this process of excluding variables, the age at which the individual entered the Marine Corps was not a significant explanatory variable when measured statistically. In the end, the current age variable, AGE, proved to be a correct choice, as it was found to be statistically significant at the one percent level in predicting success and will be discussed later.

Until some multicollinearity problems began to surface, length of service was a variable that was a candidate for inclusion into the predictive model. It is so closely correlated to characteristics such as age and grade though that it was necessary to omit it while eliminating as much bias as possible. Be that as it may, it is interesting to observe, as seen in Table 10, that those Marines currently on a five year enlistment contract fared better than all others with an attrition rate of 25.77 percent; that is nearly 11 percent less than the overall rate. In fact, upon further examination Marines, on the two longest enlistment contracts

offered had the best chance of success at MSG school. The
bulk of the enlistment lengths are four years and these
Marines failed school at a rate three percent higher that the
overall rate of 36.45 percent.

**Table 10. LENGTH OF CURRENT ENLISTMENT (IN YEARS)
FREQUENCIES BY GRADUATE AND NON-GRADUATE**

	3 YRS	4 YRS	5 YRS	6 YRS	TOTAL
GRAD	49 64.47%	649 60.37%	72 74.23%	334 68.30%	1104 63.55%
NON-GRAD	27 35.53%	426 39.63%	25 25.77%	155 31.70%	633 36.45%
TOTAL	76 4.38%	1075 61.89%	97 5.58%	489 28.15%	1737 100%

Whether a Marine was on his first second, or subsequent
enlistment had no substantial bearing on the non-graduation
rate. The non-graduation percentages were as follows: on
first enlistment - 37.60 percent; on second enlistment - 36.05
percent; and on third or more enlistment - 36.0 percent. This
variable was not utilized.

For a number of the variables it becomes immediately clear
that some of their categories did not have enough observations
from which to base any analysis on. For instance, only 33 of
the 1770 Marines analyzed for this thesis were females. This
represents 1.9 percent of the total population hardly, on the
surface, a large enough figure to use as a basis for any

conclusive statements. For comparison purposes, Table 11 outlines total male and female numbers along with the graduation and non-graduation rates. Female attrition rates run nine percent higher than the males. Again though, it is

Table 11. **COMPARISON OF MALE AND FEMALE FREQUENCIES BY GRADUATE AND NON-GRADUATE**

	FEMALE	MALE	TOTAL
GRADUATE	18 54.55%	1104 63.56%	1122 63.39%
NON-GRADUATE	15 45.45%	633 36.44%	648 36.61%
TOTAL	33 1.86%	1737 98.14%	1770 100.0%

difficult to pinpoint a specific cause. As indicated in Chapter IV, because of the small population of females, they were dropped from the data set for the purposes of this thesis analysis.

A quick look at the marital status category using Table 12 shows the overwhelming majority of MSG students, as expected, are single. Not surprisingly then, a failure rate of 36.43 percent coincides closely with the overall school attrition rate of 36.45 percent. Divorced Marines showed only a slightly lower failure rate of 35.90 percent. Though there should have been no married Marines in this file, the data indicate a total of six. This can probably be attributed to

Table 12.   MARITAL STATUS FREQUENCIES BY GRADUATE AND NON-GRADUATE

	DIVORCE	SINGLE	MARRIED	WIDOW	TOTAL
GRAD	25 64.10%	1075 63.57%	3 50.0%	1 100.0%	1104 63.55%
NON-GRAD	14 35.90%	616 36.43%	3 50.0%	0 0%	633 36.45%
TOTAL	39 2.25%	1691 97.35%	6 .35%	1 .05%	1737 100%

either careless input of information or a failure on the Marines's part to provide a copy of a final divorce decree to the administration office so that his record can be updated.

Dependency was also given a cursory look. Table 13 breaks this down into those having one, two, or three dependents. The problem I encountered looking at this information initially was that the file was missing hundreds of observations when queried as to how many dependents an individual had. As a result, I had to create a dummy variable so that all those names reflecting a blank field in this category meant zero dependents. The basis for this assumption was that the administration office entering the information probably left the field blank thinking this was the same as zero. The final numbers appear to be a valid reflection of what would be expected. Due to the expected high numbers of Marines with zero dependents, the non-graduation rate closely

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mirrors that of the overall rate. Though the other
categories, those with one and two dependents, are at least
interesting to present and look at, the small number of

Table 13. DEPENDENT FREQUENCIES BY GRADUATE AND NON-GRADUATE

	0 DEPN	1 DEPN	2 DEPN	TOTAL
GRAD	1098 63.69%	18 52.94%	3 100.0%	1119 63.55%
NON-GRAD	626 36.31%	16 57.06%	0 0%	642 36.45%
TOTAL	1724 97.90%	34 1.93%	3 .17%	1761 100%

observations does not lend itself to being used as one of the
criteria for admission to the school.

Through various means of testing to be discussed later,
time in service (TIS) and time in grade (TIG) proved to be two
variables that were highly correlated and thus had to be dealt
with. Since TIG was of a much greater statistical
significance than TIS, the latter was not used in the final
predictive model. Table 14 is provided to show how I broke up
TIS initially and then how the graduate and non-graduate rates
fell out. Those Marines with between two and five years (25
to 72 months) of service appear to graduate at a higher rate
than the other year groups utilized. Of course, this TIS can
be broken up and analyzed in any manner the user cares to.

Table 14 is the most clear cut for the purposes of this thesis.

Table 14.   **TIME IN SERVICE (TIS) (IN MONTHS) FREQUENCIES BY GRADUATE AND NON-GRADUATE**

	≤24	25-36	37-48	49-72	73-96
GRAD	201 53.74%	324 67.78%	220 67.69%	264 59.13%	68 62.07%
NON-GRAD	173 46.26%	154 32.22%	105 32.31%	129 32.82%	77 40.87%
TOTAL	374 21.53%	478 27.52%	325 18.71%	393 22.63%	115 6.62%

	97-120	≥121	TOTAL
GRAD	18 62.07%	9 60.37%	1104 63.55%
NON-GRAD	11 37.93%	14 60.87%	633 36.45%
TOTAL	29 1.67%	23 1.32%	1737 100%

As described in Chapter IV, the primary military occupational specialty (MOS) was recoded and analyzed for significance and to identify trends in a couple of ways. Without much elaboration, Table 15 breaks down graduate and non-graduate rates and numbers by occfield. Some of the occfields include as few as two observations, whereas others such as 0300 (infantry) and 2500 (communications) contain a large portion of the population. (See Appendix B for occfield descriptions.) It is interesting to note here though that

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Table 15. MILITARY OCCUPATIONAL FIELD (OCCFIELD) FREQUENCIES BY GRADUATE AND NON-GRADUATE

	0100	0200	0300	0400	0800	1100	1300	1400	1800	2100	2300	2500
GRAD	56 53.85%	5 83.33%	294 68.37%	17 62.96%	29 58.00%	29 60.42%	87 60.42%	0 0.00%	33 75.00%	21 70.00%	8 53.33%	113 65.70%
NON-GRAD	48 46.15%	1 16.67%	136 31.63%	10 37.04%	21 42.00%	19 39.58%	57 39.58%	1 100.00%	11 25.00%	9 30.00%	7 46.67%	59 34.30%
TOTAL	104 5.99	6 0.35	430 24.76	27 1.55	50 2.88	48 2.76	144 8.29	1 0.06	44 2.53	30 1.73	15 0.86	172 9.90

	2600	2800	3000	3100	3300	3400	3500	4000	4300	4400	4600	5500
GRAD	6 100.00%	14 77.78%	72 54.55%	8 80.00%	19 65.52%	27 77.14%	63 50.40%	7 53.85%	1 50.00%	4 66.67%	6 85.71%	6 100.00%
NON-GRAD	0 0.00%	4 22.22%	60 45.45%	2 20.00%	10 34.48%	8 22.86%	62 49.60%	6 46.15%	1 50.00%	2 33.33%	1 14.29%	0 0.00%
TOTAL	6 0.35	18 1.04	132 7.60	10 0.58	29 1.67	35 2.01	125 7.20	13 0.75	2 0.12	6 0.35	7 0.40	6 0.35

	5700	5800	5900	6000	6100	6300	6400	6500	6800	7000	7200	TOTAL
GRAD	5 55.56%	36 60.00%	17 77.27%	23 71.88%	4 40.00%	16 69.57%	9 64.29%	11 57.89%	3 75.00%	26 61.90%	29 69.05%	1104 63.55%
NON-GRAD	4 44.44%	24 40.00%	5 22.73%	9 28.13%	6 60.00%	7 30.43%	5 35.71%	8 42.11%	1 25.00%	16 38.10%	13 30.95%	633 36.45%
TOTAL	9 0.52%	60 3.45%	22 1.27%	32 1.84%	10 0.58%	23 1.32%	14 0.81%	19 1.09%	4 0.23%	42 2.42%	42 2.42%	1737 100.00%

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the next three of the largest four occfields (in numbers of observations) have very high attrition rates from the school though no link is initially obvious: 01 - 46.15 percent, 30 - 45.45 percent, and 35 - 49.60 percent. Because of the small number of observations within some of the occfields, I grouped the occfields together by mission to see if any one of these categories showed any graduation or non-graduation trends. Table 16 delineates which MOSs were grouped together, while Table 17 outlines the graduation and non-graduation rates of the MSG school Marines within these categories.

Table 16. **ASSIGNMENT OF SPECIFIC OCCFIELDS TO MISSION CATEGORIES**

```
COMBAT ARMS - 03, 08, 18
COMBAT SUPPORT - 02, 13, 25, 26, 57, 58
COMBAT SERVICE SUPPORT - 01, 04, 11, 14, 21, 23, 28, 30,
                          31, 33, 34, 35, 40, 43, 44, 46,
                          55
AVIATION SUPPORT LOGISTICS - 59, 60, 61, 63, 64, 65, 68,
                              70, 72
```

The effect of the high 01, 30, and 35 occfield attrition rates is reflected in the combat service support category. What is interesting in Table 17 is to see that the combat arms MOSs, where traditionally a larger number of Marines with lower GTs are present than other occfields, graduate at a higher rate than the other three categories.

Because MOSs are monitored so closely to ensure they remain balanced, it would be almost impossible, and certainly

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Table 17.   OCCFIELD MISSION CATEGORY FREQUENCIES GRADUATE AND NON-GRADUATE

	COMBAT ARMS	COMBAT SUPPORT	COMBAT SERVICE SUPPORT	AVIATION SUPPORT	TOTAL
GRAD	356 67.94%	252 63.48%	358 58.88%	138 66.35%	1104 63.55%
NON-GRAD	168 32.06%	145 36.52%	250 41.12%	70 33.65%	633 36.45%
TOTAL	524 30.17%	397 22.86%	608 35.00%	208 11.97%	1737 100%

unfair to the individual Marine, to offer MSG duty only to certain MOSs or in certain percentages to MOSs. Thus, recruitment to MSG duty in this manner is not desirable and was not included in the model.

C. ANALYSIS OF VARIABLE FREQUENCIES USED IN THE MODEL

Based on previous MSG school attrition studies (Akst and Quester, 1992; Wiskoff, et al., 1989), it was logical to assume that PFT, rifle, and GT scores would probably be among those variables or background characteristics that best predicted success at MSG school and would thus be included in the final predictive model. That assumption proved to be correct.

In addition, the variables age, grade, race, and TIG were found to be predictors of success at a statistically significant level at the school. Table 18 provides a definition and discussion of these variables.

Table 18.   DEFINITION AND DISCUSSION OF VARIABLES USED IN THE MODEL

PFTSCORE - represents actual PFT scores held in the HMF for Marines in this data file; scores were missing from twelve records. The positive coefficient sign indicated the probability of success at MSG school increased as the PFT score increased.

RIFLESCR -represents actual rifle scores held in the HMF for Marines in this data file; scores were missing from 126 records. The positive coefficient sign indicated the probability of success at MSG school increased as the rifle score increased.

GTVE - computation of selected scores from the ASVAB that comprise the General Technical or GT of a Marine; scores were missing from 20 records. The positive coefficient sign indicated the probability of success at MSG school increased as the GT score increased.

AGE - reflects the current age of Marines in this data file; all records contained an age. The negative coefficient sign indicated the probability of success at MSG school decreased as age increased.

RACE - broken down into WHITE, BLACK, AND HISPANIC, it is the respective race for those Marines in this data file; WHITE was used as the base case for this dummy variable since it represented the most observations of the three; all records contained a race code. The negative coefficient for both BLACK and HISPANIC indicated the probability of success was less than that of a white person.

TIG - represents the number of months a Marine in the data file has spent in that grade; TIG information was missing from nineteen records. The positive coefficient sign indicated the probability of success increased as the number of months TIG increased.

After these seven background characteristics were determined to be the best independent variables for the model, it was interesting, but more importantly imperative, to determine at what point cutoffs needed to be established to

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identify the most likely MSG school graduate. Frequencies were run on each of the categories to help establish this.

For PFT score, it seemed logical to first divide the scores into each of the three classes already established by the Marine Corps for this variable - first class (score of 225-300), second class (score of 175-224), and third class (score of 135-174). Table 19 contains the results. It is apparent that those Marines with PFT scores less than 225 points fail to graduate from MSG school in proportions well above 50 percent, but that the number in this category is only about 8.5 percent of the observations. Of course, it is

Table 19. PFT CLASS FREQUENCIES BY GRADUATE AND NON-GRADUATE

	1ST	2ND	3RD	TOTAL
GRAD	1038 65.86%	58 43.28%	5 33.33%	1101 63.83%
NON-GRAD	538 34.14%	76 56.72%	10 66.67%	624 36.17%
TOTAL	1576 91.36%	134 7.77%	15 .87%	1725 100%

NOTE: 12 scores were missing from the data file.

unrealistic that the Marine Corps only accept Marines possessing a first class PFT into the MSG program.

Thus, first class scores were broken down further into scores outlined in Table 20. These figures are provided for comparison and use later when trying to determine the optimum

PFT score for selection to MSG school. As expected, the higher a PFT score, the more likely the individual is to graduate from the school.

Table 20.   SELECTED PFT SCORE CUTOFFS BY GRADUATE AND NON-GRADUATE

	≥280	≥270	≥260	≥250	≥240
GRAD	424 73.98%	627 71.99%	767 69.79%	871 68.47%	401 31.53%
NON-GRAD	153 26.52%	244 28.01%	322 30.21%	401 31.53%	459 32.53%

The rifle score (qualification is with an M16A2 rifle) is another variable that lent itself to division by category. In the Marine Corps, rifle scores are delineated by expert (score of 220-250), sharpshooter (SS) (score of 210-219), and marksman (MM) (190-209). A fourth category, unqualified (UNQ), was established for those scoring less than 190 points on the rifle range. Table 21 provides a breakout of these marksmanship levels into graduate and non-graduate rates. Except for the unqualified category the graduation rates decrease as rifle scores decrease. But again, the MSG program cannot limit itself to only taking those who qualify as an expert on the rifle range. For further analysis and use cutoffs were reestablished with no regard to category. These are listed in Table 22. Just as seen when broken into

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Table 21. RIFLE CATEGORY FREQUENCIES BY GRADUATE AND NON-GRADUATE

	EXPERT	SS	MM	UNQ	TOTAL
GRAD	499 68.36%	289 66.13%	230 54.12%	12 63.16%	1030 63.94%
NON-GRAD	231 31.64%	148 33.87%	195 45.88%	7 36.84%	581 36.06%
TOTAL	730 45.31%	437 27.13%	425 26.38%	19 1.18%	1611 100%

NOTE: 126 scores were missing from the data file.

Table 22. SELECTED RIFLE SCORE CUTOFFS BY GRADUATE AND NON-GRADUATE

	≥225	≥215	≥210	≥205	≥200	≥195
GRAD	302 70.07%	642 68.23%	788 67.52%	858 66.41%	914 65.10%	963 64.67%
NON-GRAD	129 29.93%	299 31.77%	379 32.48%	434 33.59%	490 34.90%	526 35.33%

categories (Table 21), graduation rates decrease as rifle scores decrease. Again, this information is provided for use later in helping to establish the optimum model for selection to MSG school.

The GT score is not divided into classifications or categories. It is the only variable used in the model that has an established cutoff for selection to the MSG program, that is, a score of 90. In relation to this, an individual must have a score of 80 to gain entry into the Marine Corps, while a 110 GT is required for application to the warrant

officer program, and a 120 score is required for application to any commissioned officer program. Table 23 provides a comparison of different arbitrarily established cutoffs for GT and their graduation and non-graduation rates. Graduation rates increase as the GT score increases. What is interesting, and to some degree alarming, is the whopping 50 percent failure rate from MSG school when the GT score minimum is waived to accept a Marine with a GT of less than 90. Wiskoff et. al. (1989), first noted this same pattern and

Table 23.   SELECTED GT SCORE CUTOFFS BY GRADUATE AND NON-
             GRADUATE

	≥120	≥115	≥110	≥105	≥100
GRAD	275 71.99%	402 71.53%	555 69.11%	742 67.39%	869 65.88%
NON-GRAD	107 28.01%	160 28.47%	249 30.97%	359 32.61%	450 34.12%

	≥95	≤94	≤89
GRAD	998 65.10%	96 52.17%	13 50.0%
NON-GRAD	535 34.90%	88 47.83%	13 50.0%

recommended that no waivers be given for GT score. However, this recommendation was not heeded and the trend continues. Even those with a GT of less than 95 have an unacceptably high attrition rate of almost 48 percent.

Though the program cannot accept only the high-end GT score applicants, neither can it afford to take the low-end candidates. However, the exact answer becomes even more muddled when we see that even those with a GT between 100 and 110 (not shown in Table 23) fail the school at a rate of 39 percent. In addition, the commander of a Marine who really wants to be on MSG duty but continues to come up just short of the prerequisites probably does not want, nor perhaps should he have, the commander's discretion of requesting a waiver taken away from him. He is the one who observes the Marine on a daily basis and knows better than anyone whether the Marine has the skills to succeed at MSG school. The commander certainly will not stick his reputation on the line if he doesn't believe in the Marine because he doesn't want to make himself look bad in the process.

The ASVAB test can be retaken once every six months and remedial education is available for the Marine who has the potential, albeit his GT score, to do well at MSG school and ultimately on the program. Utilizing the GT as a measure of success, the Marine Corps must look hard at the numbers herein and somehow do a better job at selecting Marines for admission to MSG school.

Age is another decidedly arbitrary category from which to base selection to MSG school, but one which is statistically significant at the ten percent level. Table 24 shows how I elected to look at this variable. In this picture, except for

those in the outlying group of 26 years of age and older, we can see that the younger a Marine is the less likely he is to graduate from MSG school. However, it is worth noting that when examining ages by individual year there is no consistency or trend with regard to graduate and non-graduate rates.

Table 24. CURRENT AGE FREQUENCIES BY GRADUATE AND NON-GRADUATE

	19-21	**22-23**	**24-25**	**≥26**	**TOTAL**
GRAD	495 63.71%	320 64.26%	158 66.39%	131 58.48%	1104 63.55%
NON-GRAD	282 36.29%	178 35.74%	80 33.61%	93 41.52%	633 36.45%
TOTAL	777 44.73%	498 28.67%	238 13.70%	224 12.90%	1737 100%

These rates fluctuate by age. Only when segregated into age groups that closely resemble the grade which an individual has achieved by that age, as I have done in Table 24, do we see any trend. Though difficult to pinpoint exactly why the younger Marine experiences higher attrition, the issue of maturity is a possible cause. For example, we have an older Marine (22-25 years old) who has, as we shall see next, probably attained the rank of E4, been in the Marine Corps for awhile, lived through many experiences, and has set as another goal, to become an MSG. He is goal-oriented and knows exactly what he wants to do. The younger Marine, probably an E3, is still going through stages of immaturity and is not quite sure

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quite sure what he wants or whether he'll even stay in the Marine Corps, while the oldest Marines, perhaps, just can't seem to find their niche.

The original variable GRADE was broken down through the use of dummy variables using the separate variable categories of E3, E4, and E5. Based on that, and as seen and discussed previously with the age variable, it is no surprise that as Table 25 shows, E3s and E5s failure rate from MSG school is much higher than that for E4s. Utilizing this information, perhaps consideration should be given to accepting a higher number of E4s while decreasing the number of E3s and E5s

Table 25. GRADE FREQUENCIES BY GRADUATE AND NON-GRADUATE

	E3	E4	E5	TOTAL
GRAD	480 59.19%	506 68.19%	118 64.13%	1104 63.55%
NON-GRAD	331 40.81%	236 31.81%	66 35.87%	633 36.45%
TOTAL	811 46.69%	742 42.72%	184 10.59%	1737 100%

selected for the school. A 40 percent attrition rate for E3s, to the naked eye, seems quite high. Answering the question why, may be the first step.

Race was divided into three distinct categories to determine the effect, if any, and relation to graduation

rates.   Again, anyone other than a black or hispanic was
considered white as explained in Chapter IV. Table 26 shows
that whites graduate from MSG school at a higher rate than

Table 26. RACE FREQUENCIES BY GRADUATE AND NON-GRADUATE

	WHITE	BLACK	HISPANIC	TOTAL
GRAD	855 66.74%	200 55.71%	49 50.52%	1104 63.77%
NON-GRAD	426 33.26%	159 44.29%	48 49.48%	633 36.45%
TOTAL	1281 73.75%	359 20.67%	97 5.58%	1737 100%

non-whites. Quite alarming is the hispanic attrition rate of
almost 50 percent.   Unfortunately, it is difficult to
ascertain exactly, without more information from MSG school,
what the cause of failure from the school was. It is easy to
speculate that educational background is the cause of this
academic failure. However, this may not be the case. Some
attention should be given to researching the cause so
appropriate action can be taken if, and where necessary, to
correct the situation. If it is relevant, the Marine Corps
may also want to look at whether the numbers by respective
race on the MSG program are representative of the numbers by
race in the entire Marine Corps.

Since there is no magical cutoff for the amount of months
a Marine spends in grade in the grades being analyzed, I

elected to simply look at the TIG variable in twelve month increments. Table 27 outlines these results. Those Marines contained in the data file with less than twelve months, or

Table 27.   TIME IN GRADE (TIG) FREQUENCIES BY GRADUATE AND NON-GRADUATE

	0-12	13-24	25-36	37-48	49-	TOTAL
GRAD	351 58.02%	414 66.24%	214 66.67%	76 66.67%	34 64.15%	1089 63.4%
NON-GRAD	254 41.98%	211 33.76%	107 33.33%	38 33.33%	19 35.85%	629 36.6%
TOTAL	605 35.22%	625 36.38%	321 18.68%	114 6.64%	53 3.08%	1718 100%

NOTE: Nineteen records were missing from the data file.

one year, TIG regardless of grade, fail to graduate from MSG school nearly 42 percent of the time. This rate appears quite high. When a Marine has between one and four years (13 to 48 months) TIG, that rate drops to below 34 percent and then increases again when TIG is greater than four years. These results tie in somewhat nicely with the findings for age and grade previously discussed. The majority of the time a Marine applying to the MSG program in the grade of E3 will most likely be promoted before he has 12 months TIG. Thus, it is E4s and E5s who are most likely to have more than 12 months TIG. With graduation rates higher in the 13 to 48 month TIG category, the link can then be seen through the higher graduation rate of E4s than E3s.

D.   CORRELATION AND MULTICOLLINEARITY

1.   Multicollinearity

Imperfect multicollinearity, which is what is typically meant when the word multicollinearity is used, is a linear relationship between two or more independent variables that is so strong that it can significantly affect the estimation of the equation. For more on this theoretical and sample phenomenon see Studenmund (1992). Multicollinearity exists in virtually every data set to one degree or another. The question to be answered then is how severe is the multicollinearity in a given sample and will the results be biased by not dealing with it (i.e., leaving it as is) or will the results be skewed by manipulating it (i.e., dropping variables).

Variance Inflation Factor (VIF) is a method of testing this severity. A high VIF, generally considered greater than five, indicates multicollinearity has increased the estimated variance of the estimated coefficient yielding a decreased t-score. Further discussion of VIFs can be found again in Studenmund (1992) and SAS Institute, vol.2 SAS/STAT (1991).

A VIF test was initially conducted on all of the data set variables. Three were above five - age, age at entry into the Marine Corps, and TIS. Age at entry into the Marine Corps was discarded because I thought it was too closely correlated with grade, TIS, and TIG. After this, only one variable, TIG,

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had a VIF above five, while four variables had a VIF of around two, and one variable, E5, had a VIF of three. Upon deleting TIS, three variables remained with a VIF of two - age, E5, and those on their first enlistment. Since enlistment lengths and the enlistment number the Marine is currently on are closely associated with age and grade, I decided to delete these two variables from the model. This left the variables described at length in section C. All variable VIFs used in the final model were below two except for age which recorded a 2.05. This would appear to indicate a good fit with little unexplained variation. A further examination should, if the model is defined properly, verify this. The key to this whole process was whittling down the variables to a manageable, yet accurate, number wherein the user would not be overwhelmed by too many and perhaps vague variables to use for a prediction computation. Deleting variables is a sensitive area, since one must be careful not to discard any variables that possess significant explanatory power.

2. Correlation

A rule of thumb used by statisticians (Studenmund, 1992) is that a correlation coefficient in excess of .50 generally implies serial correlation is present in the equation. This correlation exists when two or more variables are attempting to explain the same information. The correlation coefficients for this model are shown in Table 28.

Only two areas fall into this category of concern. They are
the relationship between TIG and age, defined by a correlation

Table 28. TABLE OF PEARSON CORRELATION COEFFICIENTS

	GRAD2	PFTSCORE	RIFLESCR	GTVE	AGE	E4	E5	BLACK	HISPANIC	TIG
GRAD2	1.00000	-0.20411	-0.11767	-0.12607	0.04219	-0.08319	-0.00410	0.08323	0.06591	-0.05854
PFTSCORE	-0.20411	1.00000	0.09811	0.00301	-0.03684	0.11055	-0.02195	0.04210	0.00282	0.00572
RIFLESCR	-0.11767	0.09811	1.00000	0.17801	0.10677	0.15155	0.10600	-0.12857	-0.02487	0.09008
GTVE	-0.12607	0.00301	0.17801	1.00000	-0.01539	0.05453	-0.01023	-0.34328	-0.06385	0.05532
AGE	0.04219	-0.03684	0.10677	-0.01539	1.00000	0.13677	0.52480	0.09440	-0.01773	0.49971
E4	-0.08319	0.11055	0.15155	0.05453	0.13677	1.00000	-0.29724	0.01048	-0.00728	0.01512
E5	-0.00410	-0.02195	0.10600	-0.01023	0.52480	-0.29724	1.00000	0.06455	-0.02668	0.23224
BLACK	0.08323	0.04210	-0.12857	-0.34328	0.09440	0.01048	0.06455	1.00000	-0.12413	0.03826
HISPANIC	0.06591	0.00282	-0.02487	-0.06385	-0.01773	-0.00728	-0.02668	-0.12413	1.00000	-0.04765
TIG	-0.05854	0.00572	0.09008	0.05532	0.49971	0.01512	0.23224	0.03826	-0.04765	1.00000

are defined at a .52 correlation rate. Both are close to the
established cutoff of .50. It is easy to see why they would
be correlated. Most Marines are E5s by a certain age since
the bulk of them are eighteen and nineteen years old upon
entry. This spills over into also having roughly the same
amount of months TIG by a given age.

To ensure there was little unexplained serial
correlation on the model proposed in Section C, a test known
as the Durbin-Watson (DW) (see Studenmund, 1992) was conducted
using all of these variables. The Durbin-Watson test utilizes
a formula that produces the D-statistic. If the D-Statistic
equals zero there is extreme positive correlation; if the D-
statistic equals four there is extreme negative serial
correlation present; and if the D-statistic equals two no
serial correlation is present. For this model, the D-
statistic equalled 1.923, considered very close to two and

indicative of no serial correlation. Thus, through the proper use of testing and analysis serial correlation does not appear to be a problem or prevalent in this model.

E.   ANALYSIS OF THE PREDICTIVE MODEL

Table 29 lists those variables, which were determined by various statistical methods within SAS and mentioned in Sections A and C of this chapter, that comprise the model that is most apt to predict success at MSG school. This is based on the data file used for this thesis and the methodology used. Though the statistical significance level may change slightly over time, the variables will probably not change since the data covered a long period of time. Only if new variables are considered or requirements for selection to the school change will these variables likely change.   T h e intercept is the dependent variable identified as success or graduation from MSG school and labeled as "GRAD2" in the computer program. The remaining variables in Table 29 are independent variables from the HMF. The coefficient values for each of these are derived as a result of weighting these variables against each other in the logit model. The coefficient thus indicates the probability of change for that particular variable based on one increment of change for that same variable in the logit model. A few examples are warranted for understanding.

Table 29.   VARIABLE COEFFICIENTS, STANDARD ERRORS, AND PROBABILITY VALUES

VARIABLE	COEFFICIENT	STANDARD ERROR	CHI-SQUARE PROBABILITY
INTERCEPT	-4.8167	1.3348	0.0003
PFTSCORE	0.0157	0.00205	0.0001
RIFLESCR	0.0103	0.00441	0.0200
GTVE	0.0141	0.00536	0.0086
AGE	-0.1343	0.0312	0.0001
E4	0.4695	0.1311	0.0003
E5	0.6099	0.2424	0.0119
BLACK	-0.3789	0.1440	0.0085
HISPANIC	-0.4443	0.2360	0.0598
TIG	0.0208	0.00527	0.0001

Example 1.   Since the PFTSCORE coefficient is positive this says the probability of success at MSG school will increase .0157 percent as the actual PFT score increases one point. Hence, the higher the PFT score, the more likely a Marine is to graduate from school.

Example 2.   The negative coefficient sign for AGE indicates that for each one year increase in age the probability of success at MSG school decreases .1343 percent.   Hence, the older a Marine is the less likely he is to complete MSG school.

Example 3.   The probability of an E4 graduating from MSG school is .4695 percent more likely than an E3 (base case).

Example 4.   The negative coefficient sign for HISPANIC indicates that the probability of an HISPANIC graduating from MSG school is .4443 percent less likely than a WHITE (base case).

Example 5. The positive coefficient sign for TIG indicates that for each additional month a Marine spends in grade the probability that he will graduate from MSG school increases .0208 percent.

When discussing these percentage increase and decrease probabilities remember that these were calculated to reflect the effect and impact of the particular variable only when used in conjunction with the other variables in the logit model. When analyzed separately, the probabilities may look quite different.

The chi-square probability value in Table 29 indicates that all variables are statistically significant at the ten percent level. More ideally all but one (HISPANIC) are significant at the five percent level, and most ideally all but three (HISPANIC, E5, and RIFLESCR) are significant at the one percent level.

By plugging a base case set of probability values into the logit model (explained in Chapter IV) the probability of a particular person having success at MSG school with certain characteristics can be calculated. The best way to demonstrate this effect is through the use of examples.

Case 1. In this equation, a base case, that is those variables listed in Table 29, is established using the means for the respective variables. Recall that WHITE and E3 are the base case variables for race and grade respectively,

established through the use of dummy variables.   Thus, the
equation and calculations look like this:

$$c = -4.8167 + .0157(263.55) + .0103(215.77) + .0141(109.14)$$
$$\text{INTERCEPT} \quad\quad \text{PFTSCORE} \quad\quad\quad \text{RIFLESCR} \quad\quad\quad \text{GTVE}$$

$$-.1343(22.43) + .0208(19.52) = .476006$$
$$\text{AGE} \quad\quad\quad\quad \text{TIG}$$

Where:

$$P \ (\textit{Success at MSG School}) = \frac{1}{1 + e^{-(.476006)}} = .6169447 \approx 61.7\%$$

So, the probability of success for a white Marine, E3, age
22.43 years, with a PFT score of 263.55, a rifle score of
215.77, a GT score of 109.14, and 19.52 months TIG is 61.69
percent.

Case 2.   A Marine possesses the following background
information:

        PFTSCORE-275   AGE-21   RACE-WHITE
        RIFLESCR-220   GT-115
        TIG-36 MONTHS   GRADE-E3

Using the logit formula as demonstrated in Case 1, the
probability of success for this Marine at MSG school is
computed at 78.86 percent. Explained another way, the effect
on this Marine with the above characteristics and information
succeeding at MSG school is increased by 78.86 - 61.69 = 17.17
percent, in comparison to the Marine in Case 1.

Case 3. A Marine possesses the same background information as
Case 2 except this Marine is black.   Thus, when -.3789 is
added to the equation the resultant probability of success is
calculated to be 71.87 percent. This means the effect on this

Marine succeeding at MSG school is decreased by 78.86 - 71.87 = 6.99 percent when compared to the Marine in Case 2.

Case 4. Probably one of the best models created, but certainly impractical, is that using a Marine with the following background characteristics:

PFTSCORE-280	AGE-20	RACE-WHITE
RIFLESCR-225	GT-120	
TIG-42 MONTHS	GRADE-E4	

When calculated, this individual has a probability of succeeding at MSG school of 90.43 percent; that's less than a ten percent attrition rate. The effect on this Marine succeeding at school is increased by 90.43 - 61.69 = 28.74 percent in comparison to the Case 1 Marine. Again though, these scores are exceedingly high and it would be unrealistic, not to mention impossible, to find enough Marines to limit qualifications to those of this case. The case is only presented as an example to demonstrate to what extreme the variables in this model would have to be in order to cut attrition to a level of 10 percent.

Case 5. Perhaps the most practical case of those illustrated, wherein attrition is held under 30 percent, is the one of a Marine with the following background characteristics:

PFTSCORE-275	AGE-21	RACE-WHITE
RIFLESCR-210	GT-105	
TIG-24 MONTHS	GRADE-E4	

The probability of this Marine succeeding at school is 78.46 percent. If the race is changed to BLACK, the probability of success decreases 7.09 percent to 71.37 percent. If the race

is changed to HISPANIC, the probability of success decreases 8.44 percent to 70.02 percent. Even with these decreases in the probability of success the attrition rate still remains below 30 percent in comparison to the 36.45 percent rate computed from the actual data used for this thesis.

Obviously, the probability of success is dependent on the background characteristics of each individual considered for MSG school. This probability can be determined with some accuracy by plugging the required information into the logit model as demonstrated.

There is a method available in the SAS computer package that will save the time of hand calculating the probability results, but the initial information still must be input to the computer for each individual case. It should be possible to develop an interface program that will go into the data base and key on one variable such as SSN and then read the requested data for that individual into the logit program and calculate the required probability.

Thus, selected background characteristics must be analyzed for each Marine since the probabilities of success can deviate from each other quite a bit. Because of the current high attrition rate and the associated costs of this attrition, it is important that a more thorough scrutiny of these applicants be accomplished prior to acceptance to MSG school.

VI. NON-DATA FACTORS

A probability model has now been defined using select background characteristics of an individual that will help determine who the best candidates are for selection and ultimately graduation from MSG school. This approach, in and of itself, would be fine if we lived in a "perfect world." Unfortunately, this is not the case. Thus, when examining this issue of trying to predict success at MSG school while at the same time lowering the attrition rate, it is not realistic to look strictly at data that a computer generates. Instead, other issues, which I refer to as non-data factors, must also be examined and included in any decision regarding assignment to MSG school. These factors include, but are not limited to: the role of the commanding officer, the level of desire the Marine has to be at school, financial problems, family problems, substance abuse problems, leadership, and maturity.

A vital aspect in the success of any military organization is the role played by the commanding officer. He undertakes enormous responsibility upon assumption of command. With the lives of many men and women now in his hands, comes the latitude to make decisions on what is best for his unit. This may range from training and operational aspects to whether or not there will be hot chow in the field. He is the one that

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is most "in-tune" with what the unit can or cannot do; what it is capable of or not capable of achieving. This "hands-on" approach is consistent with leadership and management theory and models that typically describe this role as one that "makes up" for the inadequacies of other parts of a system (i.e., structure, goals, values, computer analysis, etc.). The commanding officer quickly begins to assess and realize the capabilities and limitations of his or her Marines first hand. Regardless of what data in a service record book (SRB) may say, it is the commander that probably knows if a Marine has family problems, financial problems, a substance abuse problem, a girlfriend that he is quite serious about or who is pregnant, or, probably most importantly, whether there is a lack of leadership skills and maturity. These things are some of the reasons for failure from MSG school. It is the commander who should know if these problems exist and thus whether one of his or her Marines has "what it takes"; the requisite motivation, determination, and interest in the MSG program to successfully complete the school.

Looking beyond the school, once out on post, Wiskoff et al. (1989), found that the more controlled, responsible, and dedicated MSGs are, the better they are able to avoid potential problem areas. These are again areas that a good commander will be able to recognize as either existing or not existing and make his or her recommendations with this in mind.

Thus, while it may be proven that a Marine with a GT below the required score of 90 has a 50 percent attrition rate from the school, this also means that 50 percent of the Marines in this category successfully complete the school. This latter group would never have gotten to the school if their commanding officer had not believed in them enough to request a waiver to the GT score requirement.

Sawyer (1978) found that an important aspect of the problem of motivating students to perform better is early recognition or identification of poor attitudes and low motivational levels. These are areas that are usually identified by a commander and would be cause not to recommend sending a Marine to MSG school. Sending a Marine to MSG school of this caliber who might otherwise be statistically qualified according to the predictor model, would just not make sense. Thus, the need for a "human touch;" decision-making by someone close to the situation who has insight into background factors that serve a predictive function and not just a decision by a computer. Sawyer (1978) also believed that such problems are best handled on a case-by-case basis by those who have a first-hand acquaintance with the individual. This further solidifies the notion that it is the commander's judgement and recommendation in conjunction with the background characteristics that must be utilized when deciding whether a Marine is qualified for MSG duty. Never should a Marine be sent to the school thinking this is just the thing

to "get him motivated." If he is not motivated to go to MSG school from the beginning, his attitude will likely not change upon arrival. In the end, it may necessarily boil down to a decision made at HQMC since they have access to all of the records of the individual in question and may have information the commander is not privy to (i.e., fitness reports from previous commanders).

Finally, should the Marine Corps ever have to revert to a non-volunteer MSG program, as the annual announcement of quotas (by major command) to the field says is possible if these quotas aren't made, much forethought will have to be put into the matter by policy makers. Marines who don't want to be at MSG school may actually try to fail, though this tactic could damage their chances at promotion and a career in the Marine Corps. Recruiting duty and drill instructor duty are considered independent duty just as MSG duty is, but restrictions imposed on MSGs are somewhat different. One of the most pronounced differences is the requirement that a Marine remain unmarried throughout the duration of his 30 month MSG tour. The incidence of Marines who are volunteers getting married prior to the end of their MSG tour continues to plague MSG Battalion and results in early relief. This not only results in disciplinary action to the Marine, but also temporarily burdens the post he was assigned to since the Marines there must then operate short-handed until a

replacement arrives from another post or the next graduating class.

Though the predictor model certainly can be used as an initial guide when trying to determine the success of a particular Marine at MSG school, the commander's recommendation must also hold some weight in the final outcome. To do otherwise would compromise the authority of the commander, an individual on the scene who has seen the Marine in action and knows what his capabilities are.

VII. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The Marine Corps, and the Armed Forces in general, face some stiff manpower challenges in the upcoming years. A shrinking defense budget and smaller manpower pools are two of the major issues that are upon us and must be dealt with now. Looking at attrition rates at our various service schools is one way to start addressing these impending changes.

During the last four years, attrition rates from MSG school have consistently hovered over 35 percent. As recently as December 1992, this rate was 38 percent for watchstanders (48 percent for SNCOs). (Miles, 1993) Marine Corps planners currently take into account this historical attrition rate when making assignments of personnel to MSG classes. That is, they will assign 38 percent more watchstanders to a class than they need to actually graduate. This is a necessity that will always exist to some degree. However, the attrition rate of 36.45 percent found as a result of data provided for this thesis is rather abysmal. When this attrition is measured in dollars (dollar cost per student not available) it should be viewed as significant and a problem that must be dealt with.

Looking at a pool of seventeen background variables available from the HMF, this research found that seven of

these were statistically significant (at the 10 percent level) in predicting success at MSG school. These seven variables represent a manageable and understandable set of characteristics available to any commander or HQMC in assessing the probability of success that any particular Marine would have at the school. Examples were given detailing how to do this utilizing the logit model.

The best case illustrated using this model was one which represented attrition from the school at only ten percent. However, the characteristics and qualifications this particular Marine would have to possess were so high that they would also qualify him for any commissioned officer program the Marine Corps currently offers. This was unrealistic, but was used to show to what extreme the Marine Corps would have to go to bring down attrition. A more practical case was demonstrated which would decrease attrition to below 30 percent. Utilizing this scenario, minimum standards would have to be established or used as a guide for Marines who apply to the program. As discussed in Chapter VI, instituting these standards could only be accomplished when used in conjunction with the local commander's recommendation. The commander is the individual on the scene who possesses knowledge of an applicant not found in any record book. He or she will know better than anyone what the capabilities and limitations of a Marine are and thus, whether the Marine should apply for MSG duty or what type of recommendation

should be forwarded. The commander should be given some minimum standards to utilize in the initial screening of an applicant to MSG school, but he or she should still maintain the authority to request a waiver to these standards based on personal knowledge and recommendations from other supervisors of the Marine.

Just as discovered during previous studies by Wiskoff et al. (1989) and Akst and Quester (1992), this study found GT and PFT scores to be significant predictors of success at MSG school. In addition, the current grade, current age, race, rifle score, and TIG of the Marine were the other variables that were found to be statistically significant and thus included in the final predictive model.

This was the first indepth look at data available from the HMF for the purposes of predicting success at MSG school, though Akst and Quester (1992) had taken a cursory glance at this area. The significance of this study was that the data analyzed were available in the HMF prior to the Marine reporting to school. Previous work by Wiskoff et al. (1989) and Sherman et al. (1978) looked at data available after the Marine graduated from MSG school. They received their data directly from MSG school and did not have access to the HMF to scrutinize all background characteristics. This "after the fact" analysis may provide different results than that which would have been obtained if analyzing these factors prior to the Marine reporting to MSG school. The attempt to identify

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who will and will not graduate from MSG school should be done using data available at the Marines' previous command and before he actually enters the school. Yet, some of the same variables identified as significant predictors of success from the previous studies were also found to hold true with this study. It is difficult to say then whether the predictive results are skewed, and if so, to what degree, when analyzing certain background information (i.e., PFT scores) on the Marine from before versus after MSG school. Regardless, it became obvious while proceeding with this study that administrative offices must do a better job at entering timely and accurate data into the JUMPS/MMS (computer keyboard entry into the Joint Uniform Military Pay System/ Manpower Management System which then becomes part of the HMF) on individual Marines. As many as 152 records in one variable category could not evaluated due to missing, incomplete, or incorrect data in the HMF.

Whether measures are taken via stiffer requirements and more thorough screening by the Marine applicants' commanding officer or there is stricter adherence to any established standards by HQMC, attrition rates for MSG school will probably always hover between 20 to 30 percent. Even though we must continue to ensure that only Marines of the highest caliber are accepted for this program, attrition above 30 percent still appears high, though this may be acceptable to the Marine Corps. Though establishing more stringent criteria

will enable fewer Marines to apply, some of whom would have graduated, I believe it is quality that will overcome the notion of quantity and still provide enough numbers for this highly visible program. Utilizing some of the thoughts and tools provided in this thesis I believe this number can be reduced. A start might be to raise the GT requirement to 95 and accept no waivers for scores below 90. At the same time require all applicants to have first class PFT scores (225 and higher). Once changes like this have been in place for a predetermined period of time, HQMC should reassess the situation to determine what further action, if any, must be enacted.

Artificial attrition rate limits should not be initially established in concrete, but goals should be set forth in this direction. If these goals can't be reached (attrition under 30 percent might be a start), only then should hard and fast rules should be established and, most importantly, be adhered to. At what point do we turn away a potential MSG applicant is the question, but this difficult and perhaps unpopular decision must be made. Some recommendations for action to determine why this high attrition exists coupled with areas for further study are included in the following section.

B. RECOMMENDATIONS

The following recommendations are made based on the research and results of this thesis:

1. A follow-on study could be undertaken to determine not only the attrition rate once Marines leave MSG school and are out on post, but also the causes. The numbers are important however, it is equally important to know why. What caused the problem? If it was an alcohol-related incident, was there anything in the Marine's past that would have indicated a problem in this area that should have been detected as part of the screening process at MSG school or the Marine's former unit? If so, perhaps we can alleviate problems of this nature in the future and thus, reduce attrition.

2. It would be useful and interesting to know why Marines in the 01, 30, and 35 occfields have a higher attrition rate from MSG school than those in combat arms occfields who traditionally possess lower GT scores. There may be a trend that has previously gone unrecognized in this area. This could become quite important should the Marine Corps ever have to resort to a non-volunteer MSG program.

3. Utilizing the variables employed in the predictive model for this study, it may be useful to develop some type of point system chart (much like cutting scores for promotion or how PFT scores are calculated) that would give the commander a snapshot, based on historical data, of the potential or

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probability of a Marine to succeed at MSG school. This could be incorporated into the commanding officer's checklist.

4. More emphasis and detailed consideration should be given to administering the LEQ <u>before</u> a Marine reports to MSG school. Currently, the test is given to all Marines once they report to the school. The results then are used in some cases as a foundation for dropping a Marine from the school. If the test had been given at the previous command and evaluated by qualified personnel, the Marine may never have been given orders to school. This amounts to a cost savings in dollars and human capital.

5. Many guesses could probably be made regarding the unusually high attrition rate of minorities from MSG school however, only a study into the <u>exact</u> causes will help the Marine Corps alleviate any disparities. Thus, the question for research: Why are minority (hispanics and blacks in this study) attrition rates from MSG school so much higher than whites?

6. Along the same lines as a study on minority attrition, the question could also be extended to determining the specific causes of attrition for each Marine. Not just the surface causes - leadership, academics, alcohol - but the root causes of these problems. Maybe there isn't an identifiable common trait, but if there is it is yet another tool to be utilized in slicing the overall attrition rate from MSG school.

7.   Are we unnecessarily hard on our Marines during MSG school? All Marines at the school appear before a formal board comprising the officer-in-charge of the school, a State Department representative, and a clinical psychologist. Is there too much latitude given these individuals in deciding to drop an individual from the school? I don't know. I only raise the question for thought. Are we screening out and subsequently dropping Marines who might have otherwise succeeded? Is the decision a subjective one or are there criteria on which to decide whether to drop a Marine from MSG school?   Perhaps these are areas that warrant further exploration.

8.   A cost benefit analysis to determine whether the MSG program is in fact cost productive to the Marine Corps should be a valid topic of concern during this period of downsizing of the force. The high visibility of the job and related positive effect on recruitment would also need to be considered in conjunction with these costs. Are we getting all the bang for our buck?   Is the State Department contributing its fair share into putting inexpensive, quality labor out on post? Many such questions need to be asked.

9.   If the Marine Corps continues to support the State Department with Marines for security duty throughout the world, an indepth look needs to be taken at the viability of a non-volunteer program.   Perhaps the biggest question is whether we can require Marines to remain unmarried during this

30 month tour. During downsizing, which may take our end-
strength to 159,000 Marines or below, qualified volunteers
will become harder and harder to find.

10. Last, just as a point to consider, we sometimes suspect
or are actually able to determine that a Marines' previous
command has not completed the checklist as required (or better
yet, not completed it to our liking). However, what we don't
know is how many Marines that the commanding officer has
turned away. He may have no fully qualified personnel to fill
the quota, but his back may be up against a wall and he has to
provide a body. Perhaps the fault doesn't always lie with the
commander, but with the system. Sister units, understandably
to some degree, don't always want to pick up the slack or an
additional quota for MSG school because they know they will
probably lose one of their better Marines. The Marine Corps
must continue to ensure that any direction or guidance that is
promulgated is clear and results are attainable.

<u>16 Personality Factor Questionnaire (16PFT), Form A, 1967 Edition</u> - A widely used psychological personality measurement instrument which evaluates sixteen different areas to determine whether an individual is: warm, bright, stable, assertive, enthusiastic, conscientious, bold, sensitive, suspicious, imaginative, shrewd, worried, radical, self-sufficient, controlled, or tense, and to what degree.

<u>Armed Forces Mental Group (AFMG)</u> - There are seven mental groups (I, II, IIIA, IIIB, IVA, IVB, V). The higher the percentile score on the AFQT the lower the corresponding mental group number. This higher score on the AFQT also signifies a higher level of trainability. (Hawes, 1990)

<u>Armed Forces Qualification Test (AFQT)</u> - An aptitude composite that consists of four of the ten ASVAB subtests: (1) word knowledge (WK); (2) paragraph comprehension (PC); (3) arithmetic reasoning (AR); and (4) numerical operations (NO). AFQT scores are used to categorize individuals into an Armed Forces Mental Group (AFMG). Minimum AFQT scores are incorporated into enlistment standards. AFQT is not used specifically for job assignment.

<u>Armed Forces Vocational Aptitude Battery (ASVAB)</u> - It is a well documented and studied battery of ten aptitude subtests administered as a screening tool to all individuals entering military service to evaluate academic and vocational abilities. Although not designed specifically as an intelligence test, the ASVAB does predict general trainability of enlisted personnel. It is the military's test for selecting and classifying new recruits. It has been studied, improved, and used for over 40 years. The military does not specifically attempt to determine the intelligence of its potential candidates however, academic portions of the ASVAB test have shown themselves to be reasonably defined measurements of intelligence. (Warner, 1987)

<u>General Classification Test (GCT)</u> - The GCT was the measure of aptitude used for enlisted Marines prior to 1980. It was a score derived from three segments of the Army Classification Battery 61. The were the verbal (VE), arithmetic reasoning (AR), and pattern analysis (PA) subtests. When the GT score was adopted by the Marine Corps as the standard measure of

aptitude or intelligence, in the late 1970's, the conversion of the GCT was done by dropping the PA score.

General Technical (GT) - The GT is that portion of the ASVAB that is considered the general intelligence score used for placement of individuals into different occupational skills and into different programs (i.e., officer, aviation). The Marine Corps GT composite is the aggregation of four component test: (1) word knowledge (WK); (2) paragraph comprehension (PC); (3) arithmetic reasoning (AR); and mechanical comprehension (MC).

Motivation Analysis Test (MAT), Form A, 1975 Edition - A complex psychological testing instrument broken down into two areas: integrated (conscious), which measures motivational needs, and unintegrated (unconscious), which measures satisfaction levels. Specifically, the scale descriptors include career, dependency, security, self-indulgence, responsibility, self-concept, heterosexuality, hostility, self-assertion, and affection. High scores reflect positive association with the scale dimension.

Physical Fitness Test (PFT) - The PFT is a measure of physical fitness taken by all Marines semi-annually. It has three parts: (1) a three mile run; (2) situps; and (3) pullups. Points which can be accumulated on this test range form zero to 300. Certain minimum scores are required to pass the PFT, based on the age group a person falls into. In addition, the PFT is divided into three classes (1st, 2nd, or 3rd) depending on age and total points. As an example, a 300 PFT would consist of running three miles under eighteen minutes, doing 20 pullups, and doing 80 situps in under two minutes.

Special Assignment Battery (SAB) - A biodata instrument developed as a tool to aid in selecting individuals for special assignments in the Navy and Marine Corps such as recruiters, drill instructors, or recruit company commanders. The SAB consists of measuring responses in sixteen areas: dominance, well-being, good natured, exhibitionism, organization, age, extroversion, methodical, religious/abstention, even-tempered, hard working, cautious, marriage (NA for the watchstander), stable, spontaneity, and delinquency.

APPENDIX B

OCCUPATION FIELD (OCCFIELD) DESCRIPTIONS

OCCUPATIONAL FIELD	DESCRIPTION
0100	Personnel Administration
0200	Intelligence
0300	Infantry
0400	Logistics
0800	Field Artillery
1100	Utilities
1300	Engineer, Construction, and Equipment
1400	Drafting, Surveying
1800	Tanks
2100	Ordnance
2300	Ammunition and Ordnance
2500	Communications
2600	Signals Intelligence
2800	Data/Communications Maintenance
3000	Supply Administration and Operations
3100	Transportation
3300	Food Service
3400	Auditing, Finance, and Accounting
3500	Motor Transport
4000	Data Systems
4300	Public Affairs
4400	Legal Services
4600	Training and Audiovisual Support
5500	Band
5700	Nuclear, Biological, and Chemical
5800	Military Police and Corrections
5900	Electronics Maintenance
6000	Aircraft Maintenance
6100	Aircraft Maintenance
6300	Avionics
6400	Avionics
6500	Aviation Ordnance
6800	Weather Service
7000	Airfield Services
7200	Air Control/Air Support/ Anti-Air Warfare

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